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STS Consultants Ltd.
111 Pfingsten Road
Northbrook Illinois 60062
312-273-5440

April 26, 1982

State of Illinois - Attorney General
Environmental Control Division
188 West Randolph Street
Suite 2315
Chicago, Illinois 60601

Attention: Dr. Howard O. Chinn

STS Project No. 22063

Reference: Contamination Surveys - U.S. Scrap Corporation and Penn Central Corporation Sites in Chicago, Illinois

Gentlemen:

We have completed the contamination surveys at the above-referenced sites. These surveys were authorized by the Illinois Attorney General's Office in order to evaluate site specific contamination caused by previous waste disposal operations.

The U.S. Scrap Site comprises approximately 4.5 acres and is located west of South Cottage Grove Avenue; east of the Chicago and Western Indiana Railroad tracks; west of the Metropolitan Sanitary District of Greater Chicago (MSDGC), Calumet Sewage Treatment Plant; and south of the Stainless Processing Company, Inc, property at 11900 South Cottage Grove Avenue.

The Penn Central Site is located southwest of the Michigan Central Railroad in an area known as the Michigan Central Railroad yards. It is in the general vicinity of the U.S. Scrap Site however it is located just east of the MSDGC, Calumet Sewage Treatment Plant property.

The conclusions presented in this report are based upon field exploration work which included drilling eight soil borings and installing eight subsequent monitoring wells (six at the U.S. Scrap Site and two at the Penn Central Site), a geophysical survey, test pits, laboratory testing, and engineering analysis. It should be noted that all chemical analyses were performed by the Illinois Environmental Protection Agency (Illinois EPA). Data which was obtained from the field explorations and laboratory testing programs is included in the Appendix of this report.

## LIST OF FIGURES

If you have any questions with regard to the information contained in this report, or if we may be of any further assistance, please do not hesitate to contact our office.

Very truly yours,

STS CONSULTANTS, LTD.

Michael G. Sibert, P.E.
Project Geotechnical Engineer

Kathryn R. Huibregtse, P.E.
Project Chemical Engineer

Charles W. Pfingsten, P.E.
Principal Engineer

MGS/ms

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# INTRODUCTION

This contamination survey was performed by STS Consultants Ltd (formerly Soil Testing Services, Inc.) for the Illinois Attorney General at sites operated by Steve Martell in Chicago, Illinois. Our work was authorized by Dr. Howard O. Chinn from the Attorney General's Office, and was performed under contractual agreements dated February 1, 1981 and July 1, 1981.

The purpose of this contamination survey was to evaluate the two sites with regard to contamination by previous waste disposal activities and to recommend conceptual remedial action options for site clean-up.

The so-called U.S. Scrap and Penn Central Sites are located in the southern part of Chicago, Illinois at the general locations shown on Figure 1, which is a photocopy of the 1963 United States Geological Survey (USGS) map of the Lake Calumet quadrangle. Both sites have apparently extensive histories of waste disposal activities which are described in the enclosed section, SITE HISTORIES.

In order to evaluate the degree of contamination at the two sites, a thorough field exploration program was developed. This program included the following:

1. Drilling eight soil borings (six at the U.S. Scrap Site and two at the Penn Central Site) at the locations shown on Figures 1, 2, and 3.

2. Installing ground water monitoring wells in each borehole at the locations shown on Figures 1, 2, and 3.

3. Performing a magnetometer survey along the approximate traverse lines shown on Figures 2 and 3.

4. Excavating test pits at the locations shown on Figures 2 and 3.

5. Obtaining ground water samples from the wells, soil samples from the borings, samples from the test pit excavations, and surface samples at the locations shown on Figure 2 for chemical analyses which were performed by the Illinios EPA.

The results of the field exploration program are included in the Appendix. These results were used in developing the conclusions and recommendations which are presented in this report.

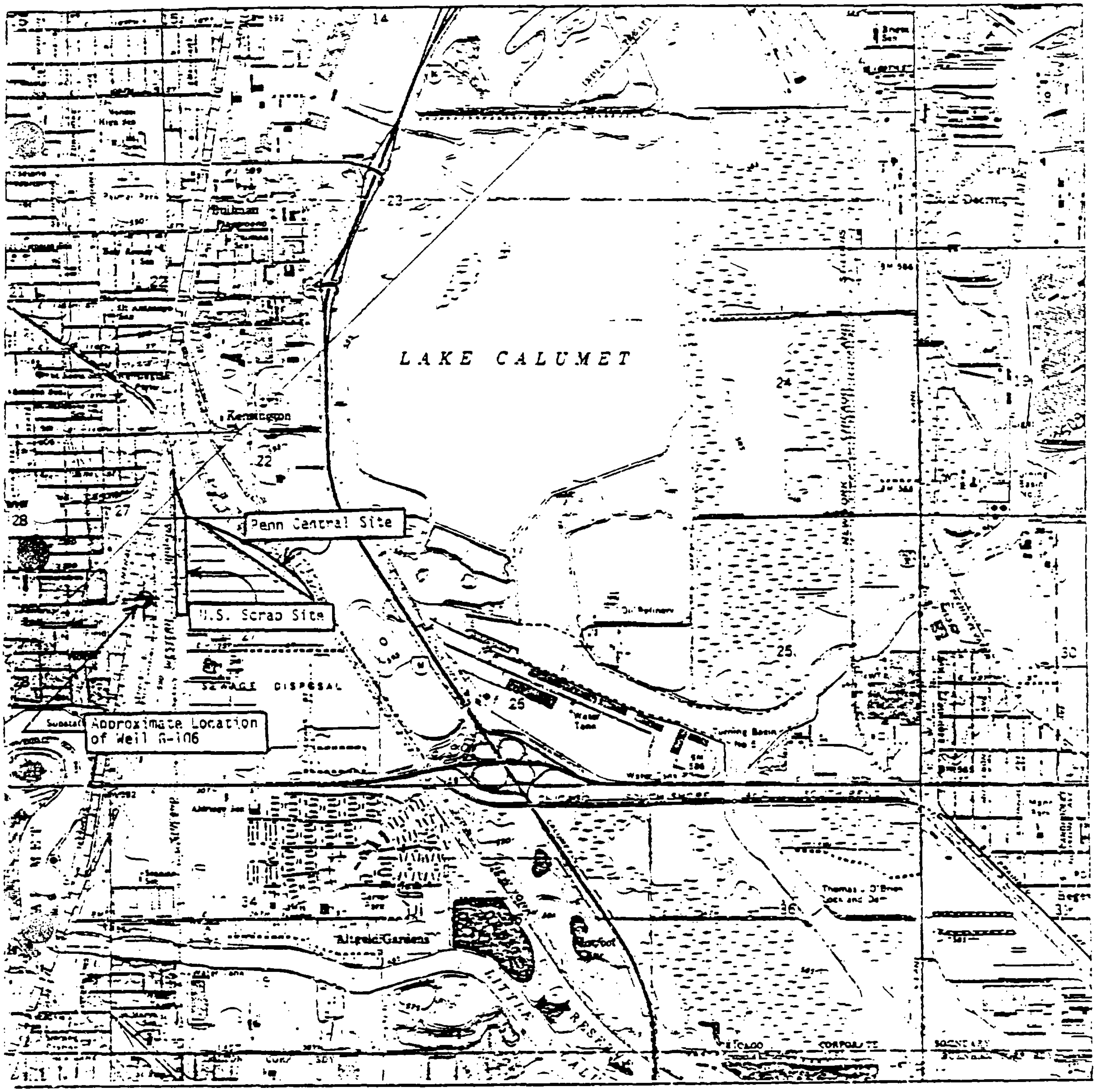



FIGURE 1

0 1 2
Approx Scale in Miles

U.S. SCRAP and PENN CENTRAL SITES

United States Geological Survey
Topographic Map of Lake Calumet (Illinois) Quadrangle
7.5 Minute Series - 19?3

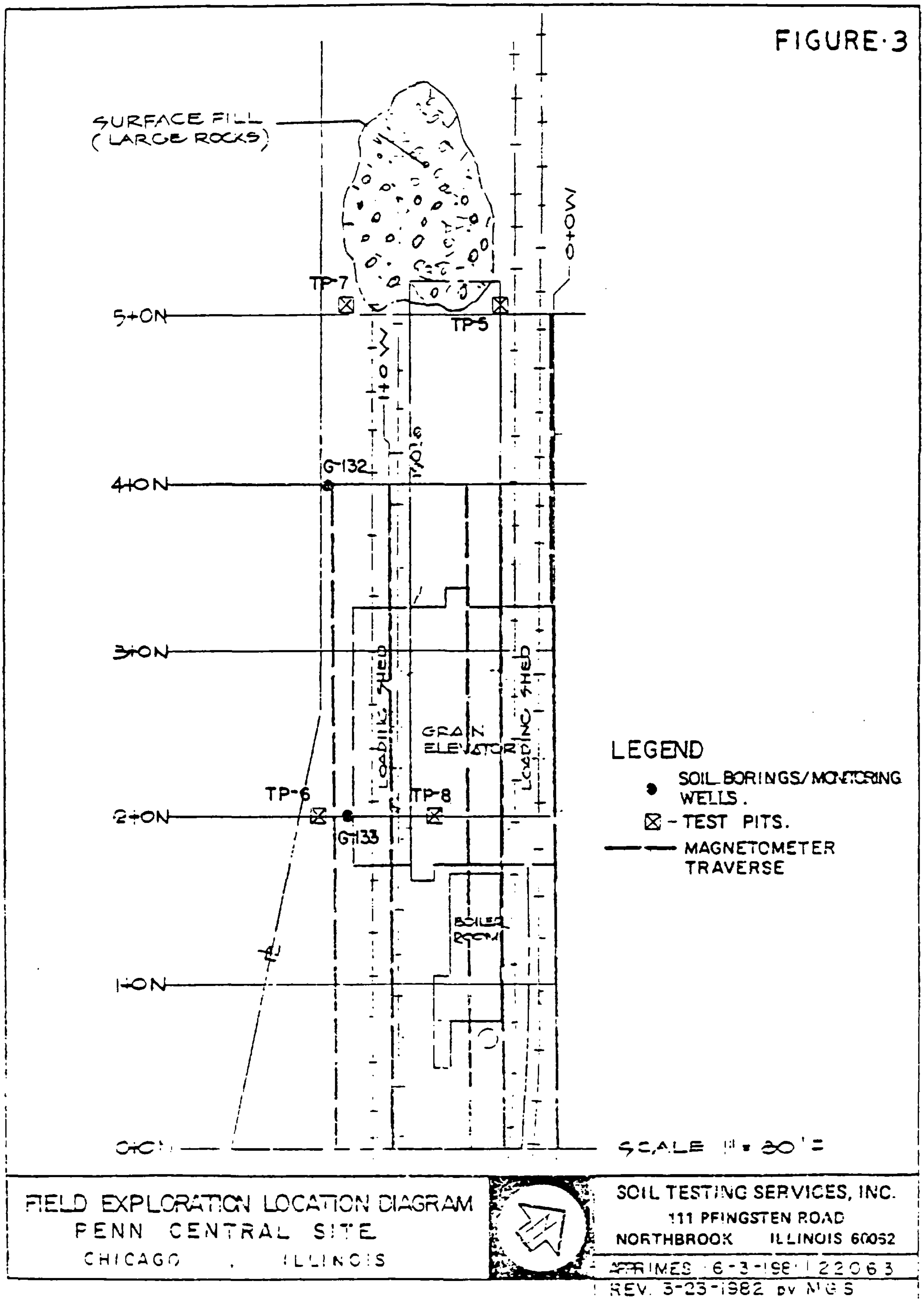


FIGURE 3
SURFACE FILL
(LARGE ROCKS)
TP-7
TP-5
0+0W
1+0W
5+0N
4+0N
3+0N
2+0N
1+0N
0+0N
G-132
G-133
TP-6
TP-8
LOADING SHED
LOADING SHED
GRAIN ELEVATOR
BOILER ROOM
LEGEND
SOIL BORINGS/MONITORING WELLS.
- TEST PITS.
MAGNETOMETER TRAVERSE
SCALE 1" = 30'
FIELD EXPLORATION LOCATION DIAGRAM
PENN CENTRAL SITE
CHICAGO, ILLINOIS
SOIL TESTING SERVICES, INC.
111 PFINGSTEN ROAD
NORTHBROOK ILLINOIS 60062
REV. 3-23-1982 by MGS

## SITE HISTORIES

STS performed a records and literature search of the U.S. Scrap and Penn Central Sites in order to facilitate the contamination survey. The histories of these sites, so far as we could learn, are described below and are subdivided into the two sites.

### U.S. Scrap Site

A malting plant (consisting of at least one large grain elevator, one tall processing building, four 50 ft diameter steel storage tanks, eight smaller diameter concrete silos and several single story brick buildings) existed at the site from sometime prior to 1908 until approximately 1967. Ground surface around the malting plant was fairly level, usually ranging from +8 to +10 Chicago City Datum (CCD).

Between 1938 and 1949, the northernmost sludge ponds at the adjacent MSDGC Sewage Treatment Plant had been constructed.

Between 1949 and 1958, more sludge lagoons were constructed at the MSDGC property, east of those referenced above.

Between 1958 and 1967, the large grain elevator at the malting plant was evidently demolished and the ground surface was raised significantly to form a "hill" in the northern part of the property. It appears likely that rubble from the grain elevator demolition was used to fill the north section of the site.

concrete tanks, however, still remained. Also, there were several new ponds, averaging 3 ft deep, along the western property line. The ponds toward the south end of the site had apparently been filled by this time. The previously mentioned "hill" on the north end of the site (suspected to contain the remains of the old grain elevator) had a new maximum elevation of +18 CCD which was 4 ft lower than the maximum elevation mentioned in Mr. Porter's 1972 report. What appeared to have happened was that the "hill" had been graded toward the northeast to create a lower and flatter "hill" than had originally existed.

We also reviewed a 1978 air photo which showed conditions similar to those described in Mr. Porter's 1975 report. At the time this air photo was taken, most of the site appeared to be relatively clean and no barrels were noted in the photo. Several semi-trailers did remain on the site however.

Evidently between 1978 and 1980 the site was reused as a disposal area because various pieces of correspondence from the Illinois EPA indicated that as many as 400 55-gal barrels were present on the site during this time.

Field observations made in May of 1981 indicated that the barrels noted in 1980 had been removed. The pit immediately to the north of the old brick buildings (observed in the April, 1973 air photo mentioned previously) still remains in the 1981 observations, as do several ponded areas along the western edge of the site. Numerous small ponds containing dark, oily fluids could be seen throughout the site in May of 1981. The only structures remaining on the site in these observations were the eight concrete silos and the abandoned incinerator.

Our research records indicate that as early as July of 1971 the U.S. Scrap Site was considered to present a pollution problem. Various complaints were lodged against U.S. Scrap by MSDGC, and U.S. Scrap was periodically ordered to implement rehabilitation measures on their site. The measures included construction of a containment berm and drainage ditch along the east side of the site which were intended to prevent runoff to the MSDGC property. Even with the remedial construction which was implemented, complaints continue to emanate from the MSDGC until the present time.

Penn Central Site

The Penn Central Site (also known as the Garvey Grain Elevator) has, like the U.S. Scrap Site, gone through a gradual change over the years that it has been in operation. The elevator was in existence prior to 1938 as noted by a 1938 air photo. A drawing which was made in 1965 indicates that the dimensions of the elevator are approximately 152 ft X 50 ft. An associated boiler plant and smoke stack (for drying the grain) existed just to the southeast of the elevator. Railroad tracks serviced the grain elevator, entering the site from the northwest, and continuing beyond the elevator to the southeast.

Air photos which were taken in 1938, 1949, 1958 and 1967 indicate very few topographic changes occuring on the Penn Central Site during this period. It is presumed that the grain elevator was in operation during this time.

An air photo which was taken in April of 1973 indicates that several tank trucks had been deposited northwest of the site and some surface rubble also appeared in this area.

## Summary

In summary, various waste disposal activities were apparently performed over the years at both the U.S. Scrap and the Penn Central Sites. Available documentation indicates that these activities began as early as the late 1960's. Many of the disposal activities reportedly concerned liquid waste which was pumped into the basements of the Garvey Grain Elevator and the grain elevator at the U.S. Scrap Site as well as into various ponds constructed on both sites. Reports made by several people indicate that 1) holes were dug in the ground, oily waste was disposed of in the holes and they were covered, 2) underground tanks were used to collect the waste, and 3) actual tanker trucks were buried. We did not find any buried tanks or trucks in our exploration however, and could not therefore confirm any of these observations.

The MSDGC was concerned about the problem in the early 1970's or late 1960's and there were many complaints and inspections made of both sites after that time.

A pit which was noted by Mr. Kenneth Kastman of STS in August of 1980 at the U.S. Scrap Site was approximately 50' X 50' in size and the liquid within it had an oily, dark brown appearance. This could be the same pit which was noted in the 1973 air photo. Mr. Kastman's observations indicated that bubbles could be seen rising to the surface at the north end of this pit. Unverified information exists which indicates that this pit could be as deep as 30 ft.

## GEOLOGY AND HYDROGEOLOGY

The potential for movement of contaminants into the ground water system is related to the geologic and hydrologic conditions existing in that particular area. Therefore, we are presenting background information relating to the geology and hydrology of the area in which the sites are located and, to the extent possible, of the subject sites themselves.

### Geology (Ref. 1)

The uppermost bedrock unit in Northeastern Illinois is comprised primarily of Silurian Age dolomitic limestone of the Niagaran Series. This bedrock is overlain by as much as 400 ft of glacial drift deposited during the Pleistocene Age by the Lake Michigan lobe of the Wisconsinan glacial advance, the last major episode of glaciation in the Midwest. The glacial sediments were deposited in the forms of hills, moraines, and outwash deposits. Once the glaciers retreated, lacustrine deposits from ancient Lake Chicago, the predecessor of Lake Michigan, accumulated. These glaciolacustrine deposits consisted primarily of silt and silty clay layers containing thin beds of more plastic clay with local lenses of sand along former beach ridges. In addition to the beach ridges, coarse granular material was deposited in spits and bars. It is these more granular deposits through which the uppermost ground water generally flows. In some areas, however, such as at the subject sites, these granular deposits have either been largely removed or they do not exist. In such cases, if fill materials have been placed, the uppermost ground water may flow through them.

The U.S.Scrap and Penn Central Sites are located on the glacial Lake Chicago plain. At these sites, the Niagaran dolomite is overlain by approximately 65 ft of glacial till deposits. The clayey till is in turn overlain by near surface fill materials. These fill materials appear to have been randomly placed and therefore they vary considerably in physical and hydraulic characteristics.

Hydrogeology (Ref. 2)

Regionally, the ground water resources in Northeastern Illinois and Northwestern Indiana are developed in four aquifer systems; 1) the unconsolidated sand and gravel deposits in the glacial soils. 2) the Silurian Dolomite aquifer underlying the unconsolidated deposits, 3) the Cambrian-Ordovician aquifer located in the deeper sandstones and 4) the Mt. Simon aquifer in the deepest formations of the Cambrian Age. It is possible that the unconsolidated sand and gravel aquifer and the Silurian Dolomite aquifer are, in some areas, hydrologically interconnected, but they are usually separated from the underlying Cambrian-Ordovician and Mt. Simon aquifers by the Maquoketa Shale formation. The Maquoketa Shale is a relatively impervious, clayey, formation and acts as an aquitard or even an aquiclude in the Northeastern Illinois area.

It can be seen, therefore, that the upper aquifers (unconsolidated glacial deposits and Silurian Dolomite) are of primary concern with regard to contamination by surface and/or near surface sources. Should contamination occur, it will probably be relegated to these aquifers beause its downward movement into the underlying Cambrian-Ordovician and Mt. Simon aquifers will be virtually prevented by the Maquoketa Shale. Studies conducted in 1957 indicated that approximately 60% of the ground water which was used in the Chicago area (at that time) came from the sand and gravel and Silurian Dolomite aquifers.

# FIELD EXPLORATION PROGRAM

Our subsurface exploration programs at the subject sites consisted of performing several operations to establish subsurface soil and ground water conditions. These operations included drilling soil borings, installing ground water monitoring wells, excavating test pits, and performing a geophysical survey.

## Soil Borings

Eight soil borings (G-101 through G-106, G-132 and G-133) were performed by STS at the locations shown on Figures 1, 2 and 3. All of the borings were extended into the clay material which was encountered below the surface fill. One boring (G-105) was extended through the clay and into bedrock which was encountered at a depth of approximately 65 ft.

Boring numbers G-101 through G-105, G-132 and G-133 were performed with a truck-mounted rotary drill rig that utilized various cutting bits and drilling fluid to advance the boreholes. This drilling fluid consisted of clean water which was used in all cases except for a small amount of Revert (an organic additive) which was utilized in Boring G-105 at a depth of 66 ft due to excessive cave-in of the weathered bedrock or gravel/boulder mix that was encountered at that depth. It should be noted that 10 ft of steel surface casing (4 inches in diameter) was necessary in each of these boreholes to maintain an open hole in the upper section which was within the fill zone.

Boring number G-106 was performed with a truck mounted auger drilling rig which utilized continuous flight augers to advance the boreholes. No surface casing or drilling fluid was required to maintain an open borehole.

Representative soil samples were obtained by means of the split-barrel and shelby tube sampling procedures in general conformance with ASTM Specifications D-1586 and D-1587, respectively. In the split-barrel sampling procedure, a 2 inch O.D. split-barrel sampler is driven into the soil a distance of 18 inches by means of a 140 lb hammer falling 30 inches. The Standard Penetration Resistance Value is the number of blows per foot of penetration for the final 12 inches of driving. This value can be used to provide a qualitative indication of the in-place relative density of cohesionless soils. This indication is qualitative since many factors can significantly affect the Standard Penetration Resistance Value and prevent direct correlation of results obtained by drill crews using different drill rigs, drilling procedures, and hammer-rod-spoon assemblies. In the shelby tube sampling procedure, thin-walled, steel seamless tubes with sharp cutting edges are pushed hydraulically into the generally cohesive soils and relatively undisturbed samples are obtained.

A field log of the soils encountered in each of the borings was maintained by the drill crew and by the STS on-site geologist (Mr. John Crowley). All soil samples obtained from the drilling operations were sealed immediately in the field and brought to our laboratory for further examination and testing. The drill crew and geologist maintained regular contact with the office engineering personnel so that proper evaluation of the soil conditions and appropriate drilling procedures could be maintained throughout the field exploration program.

Ground Water Monitoring Wells

In order to characterize the local ground water system, STS installed 2 inch diameter PVC monitoring wells at each boring location. As-built monitoring well construction details are shown on the drawings which are included in Appendix B.

Briefly, each of the monitoring wells consisted of either a 5 ft or 10 ft section of 2 inch PVC slotted well screen with a No. 10 slot (slot size = 0.010 inches). The screens were each placed at the depths shown on the individual well diagrams. Surrounding the screens, gravel filter material was placed in order to allow ground water to enter the screen area. Above the filter, a bentonite pellet seal was installed in order to minimize downward migration of surface water into the slotted screen sections.

All of the wells except G-105 were installed at depths commensurate with the surface fill/clay interface. Monitoring well G-105, however, was installed to a depth of 69.7 ft in order to determine if the water in the bedrock aquifer was hydraulically connected to the water in the upper fill. The bentonite seal was placed at a depth and in a manner so as to preclude, as much as possible, downward migration of surface water and ground water from the upper fill into the screened interval. In addition, steel casing was advanced through the near-surface fill material to minimize seepage (and subsequent cross-contamination) of the upper ground water into that contained in the bedrock aquifer.

The soil borings and the ground water monitoring wells were installed between June 22, 1991 and June 26, 1991.

## Test Pits

On June 29, 1981, nine test pits were excavated at the locations shown on Figures 2 and 3. The purpose of these test pits was to, in an expedient and cost effective manner, establish the depth and character of the various fill areas on the two sites. The test pits were excavated utilizing a backhoe which was rented from The Edward Gray Corporation, 12233 Avenue O, Chicago, Illinois 60633. The backhoe operations were observed by STS Geologist Mr. John Crowley. The results of the test pit excavations are indicated on the test pit logs which are enclosed in Appendix C.

## Geophysical Survey

Geophysical exploration methods are often used to provide continuous, qualitative data on subsurface characteristics. In these methods, areas of buried waste and zones of variable soil conditions ('anomalies') occur which identify the zone boundaries. On this project, ground probing radar and magnetometer surveys were proposed because of their general ability to detect such anomalies.

A ground probing radar system involves generating an electromagnetic pulse at the ground surface. Reflections of this pulse from surface and subsurface interfaces indicate travel times which can then be used to calculate the depths of the reflecting interface(s).

The penetration depth of the ground probing radar is generally dependent upon the wave attenuation characteristics of the near surface soils. This attenuation is related to the effective resistivity of the earth material being probed. Generally, the radar penetration depth is reduced by low resistivity subsurface materials (such as clay), whereas higher resistance materials (such as sand) allow for much greater depth of penetration. Resistivity surveys at both sites were therefore performed in order to evaluate the feasibility of utilizing ground probing radar.

The magnetometer is an instrument which measures magnetic anomalies caused by variations in substrata. The normal magnetic field at any point on the earth's surface has a specific geomagnetic inclination and intensity. In the Chicago area, this inclination is approximately $74^{\circ}$ N with a total intensity of approximately 57,000 gammas. Variations in conditions below the earth's surface can cause anomalies in both the geomagnetic intensity and inclination, which can be measured using magnetometer instruments. These anomalies can be caused by iron objects, deposits of metallic refuse, and certain rocks and soil containing sufficient amounts of metallic minerals.

Magnetometer surveys were performed at both sites on pre-determined grids and the continuous readings of the magnetometer instrument were recorded at specified distance intervals.

Data from the geophysical survey is included in Appendix D.

## LABORATORY TESTING PROGRAM

An extensive laboratory testing program was performed consisting of 1) physical analyses to accurately classify the fill and soil samples obtained in the borings and 2) chemical analyses to determine the concentrations of various chemicals in the ground water, soil, and near surface fill materials.

Physical tests of the fill and soil samples were performed by STS in its Northbrook, Illinois laboratory. The chemical testing was performed by the Illinois EPA. The results of the chemical tests are indicated on Tables 2 through 6.

### Physical Analyses

All of the samples obtained from the boring operations were visually classified in accordance with the Unified Soil Classification System. The symbols according to this system of classification are shown in parentheses following the descriptions on the boring logs. It should be noted that much of the material encountered in the soil borings consists of non-soil fill materials which are described on the boring logs in as thorough manner as possible.

Most of the soil samples obtained in the split-barrel and shelby tube samplers were subjected to water content tests and the clay samples were subjected to hand penetrometer tests as well. In the hand penetrometer test, the unconfined compressive strength of a cohesive soil is estimated, to a maximum value of 7 tons per square foot (tsf), by measuring the resistance of the sample to a small, spring-calibrated plunger. Unit dry weight tests were also performed on several of the soil samples.

Four samples of silty clay obtained in the shelby tube samplers were chosen for permeability tests. These samples were considered to be representative of the silty clay strata separating the surface fill materials from the underlying bedrock. The vertical permeability (also known as the vertical hydraulic conductivity) determined from these tests is considered to be the ability of the soil (clay) to transmit water (or leachate) from higher to lower elevctions.

The results of all the tests performed by the STS laboratory are indicated on the enclosed boring logs, test pit logs, and permeability summary sheets (Appendices A, C and E, respectively).

## Chemical Analyses

In addition to the physical tests described above, chemical analyses were performed by the Illinois EPA on:

1. Ground water samples obtained from the monitoring wells in June of 1981 (Tables 2 and 3).

2. Ground water samples obtained from the monitoring wells in October of 1981 (Tables 2 and 3).

3. Soil samples obtained from the borings (Table 4).

4. Samples of surface solid and liquid materials (Table 5).

5. Solid and liquid samples obtained from the test pit excavations (Table 6).

All of these samples were subjected to tests to determine concentrations of various inorganic and organic chemical consitutents as shown on the tables.

# SUBSURFACE CONDITIONS

This section of the report describes the fill and underlying soil and bedrock conditions that were noted in the soil borings and test pits. It should be reiterated that soil borings G-101 through G-105 were performed at the U.S. Scrap Site, as were test pits TP-1 through TP-4 and TP-9. Boring G-106 was performed approximately 1500 ft west of the U.S.Scrap Site. Borings G-132 and G-133 as well as test pits TP-5 through TP-8 were performed at the Penn Central Site. The specific fill and soil conditions are indicated on the individual boring and test pit logs (Appendices A and C).

## Fill Conditions

### U.S. Scrap Site

The fill conditions noted in the borings which were performed at the U.S. Scrap Site indicated materials which differed substantially from one boring to another. In Boring G-101, *silty clay fill was encountered from the ground surface at elevation* +15.7 CCD to a depth of 2 ft (+13.7 CCD). This silty clay fill contained traces of sand, gravel and roots and was brown, gray and black in color. Below the silty clay fill, Boring G-101 encountered tar-like material which extended from a depth of 2 ft to a depth of 14.0 ft (-1.7 CCD). This material was generally observed to be black with some rusty brown coloration from 9 to 14 ft. The material was saturated (based on field observation) throughout its depth and contained wood fragments from 2 to 7 ft and cinders and gravel from 9 to 14 ft. A strong organic odor was noted in the material from 2 to 7 ft. A strong turpentine-type odor was noted from 7 to 9 ft.

Boring G-102 encountered clayey topsoil from ground surface (+18.2 CCD) to a depth of 1.5 ft (+16.7 CCD). This topsoil material was organic and contained traces of sand and roots. It was dark brown in color. Below the clayey topsoil, Boring G-102 encountered paint sludge to a depth of 4 ft (+14.2 CCD). Below the paint sludge, black sand and cinder fill material was encountered to a depth of 5.5 ft (+12.7 CCD).

Boring G-103 encountered miscellaneous fill materials from ground surface (+13.7 CCD) to a depth of 1.5 ft (+12.2 CCD). These materials were dark brown and light brown in color and emitted no noticeable odor. Gray, gravelly fill with wood fragments was encountered from 1.5 ft to a depth of 5 ft (+8.7 CCD). From this depth to a depth of 10 ft (+3.7 CCD) granular fill (which was saturated with a fluid having a strong organic odor) was encountered. This fill was black in color and was very dense to extremely dense in consistency.

Boring G-104 encountered clayey topsoil with traces of wood, slag and paint residue from ground surface (+15.7 CCD) to a depth of 0.5 ft (+15.2 CCD). This topsoil material had a paint-like odor. Below this material, sandy and gravelly fill material was encountered to a depth of 1 ft from ground surface (+14.7 CCD). This material also had a strong paint-like odor and had a pH of between 8 and 9 as measured in the field using pH paper. From 1 ft to a depth of 2 ft (+13.7 CCD), tar-like material was encountered which contained traces of gravel, wood, and bricks. Again, this material had a strong paint-like odor. Beneath the tar-like material, black and gray sandy and gravelly fill material was encountered which extended to a depth of 4.5 ft (+11.2 CCD). This material contained traces of bricks and wood, was very dense in consistency, had a strong paint-like odor, and had a pH of between 9 and 10 as measured in the field using pH paper. From 4.5 ft to a depth of 9 ft (+6.7 CCD) sandy, tar-like fill material was encountered. This material was black and gray, medium dense, and was observed to be saturated at a depth of 6 ft from ground surface. The tar-like material had a strong turpentine-like odor.

Boring G-105 encountered black, very dense cinder fill material from ground surface (+15.2 CCD) to a depth of 2 ft (+13.2 CCD). This material had a strong paint-like odor. From a depth of 2 ft to a depth of 7 ft (+8.2 CCD) red and black brick fill was encountered which contained little clayey topsoil. The material had a strong paint-like odor.

Test pit TP-1 encountered miscellaneous fill materials consisting primarily of wood, metal, sand, silt, large concrete blocks and metal containers from the ground surface to a depth of 8 ft. This fill material exhibited a strong chemical odor.

Test pit TP-2 encountered miscellaneous fill materials consisting primarily of wood, metal, sand, silt, large concrete blocks and metal containers from the ground surface to a depth of 9 ft. It should be noted that an oily liquid substance was encountered at 6 ft in depth and that the entire test pit exuded a strong chemical odor.

Test pit TP-3 encountered cinder and slag fill from ground surface to a depth of 1.5 ft. This material was black, loose and saturated. From 1.5 ft to 3 ft in depth, an oily, saturated material was encountered. At 3 ft the test pit encountered hard white slag and terminated at this depth.

Test pit TP-4 encountered miscellaneous fill materials consisting of sand, gravel, concrete and wood which were saturated at a depth of 3.5 ft. This layer extended from ground surface to a depth of 4 ft. At 4 ft, brown and black silty clay was encountered. The test pit ended at this depth.

Test pit TP-9 encountered miscellaneous fill material consisting primarily of wood, concrete, steel drums, metal, etc. from ground surface to a depth of 7 ft at which point the test pit was terminated.

## Background Soil Boring G-106

The only fill material which was encountered in Boring G-106 was from ground surface (-9.9 CCD) to a depth of 1 ft. This fill material was comprised of black silt and cinders and was loose in consistency.

Penn Central Site

Boring G-132 at the Penn Central Site encountered sandy and gravelly crushed stone fill from ground surface (+19.8 CCD) to a depth of 6 ft (+13.8 CCD). This material was light gray and was medium dense to very dense. From 6 ft to a depth of 7 ft (+12.8 CCD), wood was encountered and no sample could be recovered. From 7 ft to a depth of 9 ft (+10.8 CCD), black and gray clay fill was encountered which contained traces of gravel, sand and wood. This material was very stiff and had a very stong paint-like odor. From 9 ft to a depth of 12 ft (+7.8 CCD), black oily cinders were encountered which were in a medium dense condition. These materials appeared to be saturated with oil or a similar liquid. From 12 ft to a depth of 13.5 ft (+6.3 CCD), black silty organic clay was encountered which was stiff to very stiff.

Boring G-133 encountered clayey topsoil from ground surface at +17.4 CCD to a depth of 2 ft (+15.4 CCD). This material was dark brown and contained little wood and trace roots. From 2 ft to a depth of 7.5 ft (+9.9 CCD), saturated wood fragments were encountered. These wood fragments were noted to be black in color. From 7.5 ft to 9.5 ft (+7.9 CCD), saturated gravel fill was encountered. This material was light gray and extremely dense. From 9.5 ft to 12 ft (+5.4 CCD) sandy clay fill (slightly tar-like) was encountered. This material was black and contained traces of wood, gravel and roots. It was very stiff and was noted to have a paint-like odor.

Test pit TP-5 at the Penn Central Site encountered silty topsoil and brick fill extending from ground surface to a depth of 1 ft. Below this material, and extending to a depth of 2 ft, the test pit encountered wood which appeared to be saturated with black colored fluid. The test pit was terminated at a depth of 2 ft.

Test pit TP-6 encountered extremely dense concrete rubble fill from ground surface to a depth of 4 ft at which point the test pit was terminated.

Test pit TP-7 encountered miscellaneous fill consisting of wood and concrete from ground surface to a depth of 3 ft at which point the test pit was terminated.

Test pit TP-8 encountered miscellaneous fill materials consisting primarily of concrete, rebar, metal and silty clay from ground surface to a depth of 9 ft at which point the test pit was terminated.

Soil Conditions

U.S. Scrap Site

Boring G-101 encountered silty clay at a depth of 14 ft (+1.7 CCD). This material was gray and very stiff. The boring terminated at a depth of 17 ft.

Boring G-102 encountered light brown silty clay from a depth of 5.5 ft (+12.7 CCD) to a depth of 7 ft (+11.2 CCD). This material was stiff and had traces of gravel and sand. From 7 ft to a depth of 12.5 ft (+5.7 CCD), brown and gray silty clay was encountered. This material had traces of gravel, sand and shale and was noted to be very stiff to hard. From 12.5 ft to a depth of 15 ft (+3.2 CCD) hard gray silty clay was encountered. The boring terminated at 15 ft.

Boring G-103 encountered natural silty clay at a depth of 10 ft (+3.7 CCD). This material was brown and gray, very stiff and contained traces of gravel, sand and shale. The layer was noted to have a strong chemical odor and extended to a depth of 17 ft (-3.3 CCD). From 17 ft to a depth of 19.5 ft (-5.8 CCD) brown and partly gray, hard silty clay was encountered. This clay exhibited slightly higher plasticity than most of the other clay samples obtained in the program. From 19.5 ft to a depth of 22 ft (-8.3 CCD), Boring G-103 encountered very stiff, silty clay. This boring terminated at a depth of 22 ft.

Boring G-104 encountered natural silty clay at a depth of 9 ft (+6.7 CCD). This silty clay contained traces of gravel and sand, was brown and gray and was very stiff. It exhibited a slight paint-like odor and extended to a depth of 13 ft (+2.7 CCD). At 13 ft, gray, very stiff silty clay was encountered which then extended to a depth of 17 ft (-1.3 CCD). The boring terminated at a depth of 17 ft.

## GEOPHYSICAL SURVEY RESULTS

The resistivity survey indicated that soils in the upper 15 to 30 ft of the Penn Central Site had resistivities varying from 5 umhos/ft to 400 umhos/ft (generally typical of silty and clayey soils). Upon evaluation of this information, it was determined that ground probing radar would be ineffective for determining the location and/or depth of subsurface discontinuities or buried materials. The resistivity data obtained at this site is summarized in Appendix D.

In addition to the resistivity survey, a magnetometer survey was performed on June 29, 1981. This survey consisted of five traverses of the site, obtaining readings every 2 to 3 ft along the traverse length of 400 ft. The survey indicated that a magnetic anomaly occurred within the area of the razed loading shed and grain elevator at the Penn Central Site. Data from this survey is also included in Appendix D.

The areas of major magnetic anomalies at the Penn Central Site occurred between Station 1+50N and Station 3+00N and between Station 1+00W and Station 1+33W. Subsequent test pit excavations indicated the presence of rubble fill, consisting of reinforcing rods, electrical conduit, and other metallic debris within a clay matrix. The test pits at the Penn Central site were excavated to a maximum depth of 8.0 ft (due to digging difficulty).

At the U.S. Scrap Site, four locations were explored using the resistivity survey. At these locations, soil resistivities ranging from 30 umhos/ft to 440 uhmos/ft (typical of silty and clayey soils) were calculated. It was again determined that ground probing radar would not be feasible at this site. The results of the resistivity survey are again summarized in Appendix D.

On June 29, 1981, a magnetometer survey was performed at the U.S. Scrap Site. It consisted of two traverses, one approximately 1,100 ft in length and a second approximately 900 ft in length. Magnetic anomalies along these traverses were minor and were likely related to previous industrial activities. They occurred primarily where the traverses extended across the mound of rubble fill and refuse near the north end of the site. Test pits performed in this area indicated that metallic and nonmetallic fill, including scrap metal, broken concrete, wood and soil, occurred throughout the rubble area.

## GROUND WATER LEVELS

Ground water levels were observed during and after drilling and at the times that samples were obtained by the Illinois EPA for chemical analysis. The observations made by the STS drill crew are noted on the individual boring and test pit logs and the observations made by the Illinois EPA are indicated on Table I (next page).

### U.S. Scrap Site

The data obtained from observations in wells G-101 to G-104 indicate that the uppermost water level at the U.S. Scrap Site appears to be perched within the near-surface fill material. Generally, ground water was encountered between +7 CCD and +15.5 CCD in these wells. It should be noted that the water levels which were observed by the Illinois EPA during the first sampling operation in June of 1981 were consistently 1.5 ft to 3.4 ft higher than those that were noted during sampling operations of October, 1981. This can probably be attributed to the fact that June is traditionally a wette. time of the year than October, causing higher water levels in the perched aquifer. These elevation fluctuations can have a significant impact on the uppermost ground water quality since many differences in fill type were noted with depth at the different well locations.

TABLE 1

Ground Water Levels in the Monitoring Wells
As Noted By the Illinois EPA While Sampling

| Well Number | Site | Elevations (CCD) Top of Casing | Ground Surface | Water Levels June, 1981 | October, 1981 |
|---|---|---|---|---|---|
| G-101 | U.S. Scrap | 16.8 | 15.7 | 12.8 | 10.6 |
| G-102 | | 18.5 | 18.2 | 15.5 | 13.8 |
| G-103 | | 14.2 | 13.7 | 10.4 | 7.0 |
| G-104 | | 16.7 | 15.7 | 13.0 | 11.5 |
| G-105 | | 16.1 | 15.2 | -13.1 | -16.1 |
| G-106 | Background Well | 11.0 | 9.9 | ---- | 8.1 |
| G-132 | Penn Central | 20.4 | 19.8 | 17.7 | 15.9 |
| G-133 | | 18.0 | 17.4 | 15.3 | 8.2 |

At both sampling times (in June and October), the water level readings indicated that Well G-102 was in the area of highest water level. The water level then sloped downward toward G-101, G-103 and G-104. It is hypothesized that there is a ground water mound which has formed within the fill in the vicinity of Well G-102 (this is also in the vicinity of the surface water lagoons). Ground water appears to be flowing radially downward away from this mound, based upon the information which we have available. A diagram of ground water conditions and flow lines which depict this mounded condition is shown on Figure 4.

Concerning the water levels in Well G-105, it should be remembered that this well(screen) is sealed within the bedrock, and water level readings made in the well will not be representative of water levels in the upper fill material. Water level readings made in G-105 indicated that the water which was contained within the bedrock at the time the readings were made generally had a piezometric level of between -13.1 CCD and -16.1 CCD. Since the piezometric level of the water in the bedrock is generally about 25 ft lower than that which is within the fill, there will be a tendency for downward vertical flow of the water in the fill toward the bedrock aquifer. Our permeability tests on the clay which underlies the fill, however, indicate that it (the clay) has a very low vertical permeability (on the order of $10^{-8}$ cm/sec) and that downward flow through the clay mass will probably be very slow.

Ground water observations in Well G-106 indicated a water level at approximate elevation -8 CCD.

## Penn Central Site

Water levels which were observed during the sampling operations in June of 1981 by the Illinois EPA indicated that the water level at the Penn Central Site was between elevation +17.7 CCD in Well G-132 and +15.3 CCD in Well G-133. In the October 1981 sampling operations, the water levels were noted to be +15.9 CCD in G-132 and +8.2 CCD in G-133. We feel that the significant drop in the water level at G-133 can be attributed to the fact that, again, October is a drier time of the year than June and the water level in G-133 dropped and dissipated into the gravel fill layer that was noted to exist between +7.9 CCD and +9.9 CCD.

While there is not enough data at the Penn Central Site to discern the direction of ground water flow, one would generally conclude that the regional flow would be somewhat in the direction of Lake Calumet (and hence, Lake Michigan). There could be localized differences, however, depending upon topography, recharge and discharge areas, and subsurface fill conditions. Since the ground water level at the Penn Central Site is at or above the water level at the U.S. Scrap Site, we do not expect that there is direct flow from the U.S. Scrap Site to the Penn Central Site.

## CHEMICAL ANALYSES

In conjunction with this contamination survey, the Illinois EPA obtained soil, water, and other liquid and solid samples from the U.S. Scrap and Penn Central Sites at various times for chemical analyses. The results of these analyses are indicated on Tables 2 through 6. The types of samples obtained, the table on which the analytical results are shown, and the month and year in which the samples were obtained are indicated below:

| Type of Sample | Table No(s). | Month/Year Sample Obtained |
|---|---|---|
| Ground water samples from wells | 2, 3 | June, 1981 |
| Ground water samples from wells | 2, 3 | October, 1981 |
| Soil samples from borings | 4 | June, 1981 |
| Samples of surface solid & liquid materials | 5 | June, 1981 |
| Samples from test pit excavations | 6 | June, 1981 |

In order to aid in evaluating the analyses performed on ground and surface water samples, the Illinois Attorney General's Office has tabulated the standards set forth in the Illinois Pollution Control Board Chapter 3: Water Pollution Regulations. These standards are shown on Table 7. This table was transmitted to STS by the Illinois Attorney General's Office on January 4, 1982, and was the basis for evaluating results for most of the inorganic parameters analyzed.

Quantitative standards for all of the chemicals analyzed have not yet been established (i.e. specific limits have not been established for most of the organic parameters measured during this project). Some guidelines are available through Water Quality Criteria documents developed by the US Environmental Protection Agency. However, these are guidelines only, rather than binding standards.

Similarly, specific concentration limits have not been developed for contaminated soils. These samples as well as the selected waste material samples collected during this project are more likely to be evaluated using criteria established under the Resource Conservation and Recovery Act (RCRA) (Ref.3). RCRA identifies as hazardous a variety of materials which either exhibit hazardous characteristics (defined by RCRA as corrosivity, ignitability, reactivity or toxicity) or which contain measurable concentrations of specified hazardous compounds.

Therefore, the evaluation of results obtained in this study is both objective and subjective. When considering organic constituents, it must be recognized that most of the contaminants analyzed are not naturally occurring at the levels measured. Secondly, analytical techniques for these chemicals are very accurate, often to the parts per billion level. Concentrations which are presented in the parts per million range indicate that significant amounts of these chemicals are present.

# TABLE 2

Chemical Analyses*
Ground Water Monitoring Wells

U.S. Scrap Site

| Chemical Constituent (ppm) | G-101 6/22/81 | G-101 10/27/81 | G-102 6/25/81 | G-102 10/27/81 | G-103 6/29/81 | G-103 10/27/81 | G-104 6/24/81 | G-104 10/27/81 | G-105 6/24/81 | G-105 10/27/81 | G-106 10/27/81 | Limits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aliphatic hydrocarbons | 1.50 | 10.00 | | | 1.30 | 54.00 | | | 22.00 | 2.70 | | |
| Biphenyl - 2 - ol | | 0.15 | | | | | | | | | | |
| C3-Benzenes | 1.00 | 6.80 | | 3.30 | 0.58 | 12.00 | | | | | | |
| C4-Benzenes | 1.30 | 3.50 | | 0.92 | 0.70 | 51.00 | | | | | | |
| C5-Benzenes | | | | | | 11.00 | | | | | | |
| 2,3 -Dihydro-4-Methylindene | | | | | | 3.20 | | | | | | |
| Dimethylnaphthalene | | 0.65 | | | | 0.57 | | | | | | |
| Ethylbenzene | | | | | 0.45 | 30.00 | | | | | | |
| Ethylmethylbenzene | | | 0.64 | | | | | | | | | |
| Ethylphenol | | 2.10 | | | | 7.10 | | 3.80 | | | | |
| Fatty Acid Methylester | | | 0.29 | | | | | | | | | |
| Isophorone | | | | | 0.40 | 18.00 | | | 2.20 | | | |
| Methylbiphenyl | | 0.22 | | | | | | | | | | |
| Methylhexanol | | | | | | | 0.96 | | | | | |
| Methylnaphthalene | | 0.57 | | 0.77 | | | | | | | | |
| Methylphenol | | 6.30 | | | | | | 11.00 | | | 6.30 | |
| 4-Methyl-2-Nitrophenol | | | | | | 3.70 | | | | | | |
| 4-Methyl-2-Pentanol | | | | | | | 22.00 | | | | | |
| 4-Methyl-2-Pentanone | 5.10 | 3.80 | | | | | 22.00 | | | | | |
| Naphthalene | 0.56 | 1.90 | | 0.81 | 0.22 | 6.70 | | 0.45 | 1.30 | 0.55 | | |
| Nitrophenol | | | | | | 3.20 | | | | | | |
| PCB's | | 0.023 | | 0.022 | | 1.20 | | 0.044 | | 0.12 | 0.0056 | |
| Phenol | | 11.00 | | | | 5.00 | | 4.30 | | | 9.50 | |
| Toluene | 4.80 | 22.00 | | | 1.30 | 46.00 | 57.00 | 32.00 | 25.00 | 7.70 | | |
| Trichloroethene | | 0.66 | | | | 4.30 | | | | | | |
| Trimethylcyclohexanol | 5.20 | | 2.00 | 1.40 | | | 1.50 | 6.50 | | | | |
| Trimethylcyclohexanone | 4.90 | 7.20 | 5.30 | 12.00 | | 5.70 | 9.70 | 21.00 | | | | |
| Trimethylnaphthalene | | 0.38 | | | | | | | | | | |
| Trimethyl-3-cyclohexene-1-Methanol Acetate | | | | | | | 1.90 | | | | | |
| Xylenes | 10.00 | 22.00 | 14.00 | 27.00 | 0.47 | 120.00 | 24.00 | 22.00 | 47.00 | 11.00 | | |
| Alkalinity | 1,300 | 1,130 | 1,050 | 2,740 | 2,500 | 3,650 | 3,200 | 2,300 | 320 | 540 | NT | NE |
| Ammonia | 52.0 | 56.0 | 20.0 | 52.0 | 22.0 | 28.0 | 80.0 | 94.0 | 0.43 | 1.2 | 3.91 | 1.5 |
| Arsenic | 0.00 | 0.018 | 0.004 | 0.05 | 0.18 | 0.12 | 0.019 | 0.13 | 0.009 | 0.09 | 0.02 | 0.05 |
| Barium | 0.3 | 2.0 | 0.2 | INT | INT | INT | INT | INT | 0. | INT | INT | 1.0 |
| BOD-5 | >2,266 | >2,192 | NT | 189 | NT | >2,147 | NT | >2,167 | NT | 371 | NT | 30.0 |
| Boron | 1.2 | 1.5 | 1.7 | 4.1 | 16.3 | 12.0 | 4.4 | 5.4 | 1.5 | 2.5 | NT | 1.0 |
| Cadmium | 0.00 | 0.01 | 0.00 | 0.00 | 1.2 | 1.3 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| Calcium | 275 | 225 | 270 | 412 | 1,389 | 1,300 | 1,189 | 1,319 | 121 | 1,186 | NT | |
| COD | 2,320 | 4,000 | 335 | 1,610 | 149,500 | 34,000 | 27,000 | 20,000 | 860 | 2,350 | 1,720 | NE |
| Chlorides | 500 | 600 | 160 | 440 | 530 | 660 | 950 | 940 | 23 | 35 | NT | 250 |
| Chromium (Cr tot.) | 0.01 | 0.69 | 0.01 | 0.22 | 0.29 | 0.30 | 0.05 | 0.33 | 0.01 | 0.12 | 0.13 | 0.05 |
| Chromium (Cr + 6) | 0.00 | 0.00 | 0.00 | 0.00 | CI | INT | CI | INT | 0.00 | 0.00 | NT | 0.05 |
| Copper | 0.02 | 0.48 | 0.00 | 0.44 | 0.66 | 0.79 | 0.01 | 0.36 | 0.18 | 0.36 | 0.51 | 0.02 |
| Cyanide | NT | 0.02 | NT | 0.37 | NT | NT | NT | 0.17 | NT | 0.00 | NT | 0.025 |
| Fluoride | 7.0 | 6.6 | 1.4 | 1.2 | 2.7 | 3.1 | 0.9 | 0.9 | 0.8 | 0.3 | NT | 1.4 |
| Hardness | 1,400 | 1,000 | 1,400 | 2,300 | 5,400 | 5,900 | 5,700 | 7,600 | 250 | 422 | NT | NE |
| Iron | 3.0 | 55.9 | 2.4 | 57.9 | 227.5 | 250.2 | 420.4 | 563.4 | 10.0 | 178.1 | 192.4 | 1.0 |
| Lead | 0.00 | 1.57 | 0.00 | 0.58 | 6.15 | 6.36 | 0.00 | 0.42 | 0.00 | 0.37 | 0.28 | 0.05 |
| Magnesium | 125 | 155 | 195 | 500 | 1,025 | 858 | 797 | 934 | 29.5 | 597 | 416 | NE |
| Manganese | 0.93 | 1.20 | 0.34 | 1.87 | 27.6 | 30.6 | 13.46 | 15.7 | 0.23 | 5.56 | 4.75 | 0.15 |
| Mercury | 0.0000 | <0.00005 | 0.0000 | <0.00005 | 0.001 | ~0.0026 | 0.0000 | 0.0000 | 0.0000 | <0.00005 | <0.00005 | [illegible] |
| Nickel | 0.2 | 0.2 | 0.2 | 0.9 | 1.9 | 2.2 | 2.3 | 3.3 | 0.0 | 0.2 | [illegible] | 1.0 |
| Nitrate-Nitrite | 0.1 | 0.1 | 0.2 | 0.0 | 42.0 | 25.0 | 0.3 | 0.1 | 0.3 | 0.1 | 0.2 | |
| pH (units) | 6.2 | 8.2 | 7.6 | 7.2 | 6.1 | 6.2 | 6.2 | 6.1 | 7.2 | 7.4 | NT | 6.5-9 |
| Phenolics | 55.0 | 84.0 | 0.350 | 0.560 | 122.5 | 120.0 | 58.75 | 52.0 | 0.270 | 0.260 | 0.095 | |
| Phosphorus | 0.12 | 2.6 | 0.18 | 2.0 | 1.1 | 5.2 | 0.25 | 4.4 | 0.32 | 3.7 | NT | 0.05 |
| Potassium | 124.0 | 153.0 | 42.0 | 119 | 1,375 | 162 | 151.0 | 178 | 3.2 | 19.0 | 10.7 | NE |
| Residue (Total) | 4,005 | 4,150 | 2,130 | 3,650 | 2,580 | 10,600 | 10,400 | 15,500 | 765 | 800 | NT | 500 |
| Selenium | 0.007 | 0.014 | 0.003 | 0.008 | 0.002 | 0.25 | 0.027 | 0.13 | 0.002 | 0.01 | 0.001 | 0.01 |
| Silver | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.005 |
| Sodium | 618 | 777 | 152 | 382 | 492 | 466 | 513 | 702 | 51.3 | 137 | NT | NE |
| Specific Conductance (umhos/cm) | 4,346 | 4,678 | 2,021 | 4,901 | 6,337 | 5,494 | 7689 | 10,193 | 629 | 1,100 | NT | NE |
| Sulfate | 250 | 65 | 290 | 33 | 1,220 | 1,040 | 352 | 1,240 | 30 | 59 | NT | 250 |
| Zinc | 0.2 | 5.1 | 0.1 | 1.7 | 122 | 123 | 0.2 | 11.1 | 0.4 | 5.2 | 0.5 | 1.0 |

*Analyses performed by the Illinois Environmental Protection Agency

**As submitted to STS by the Illinois Attorney General's Office on January 4, 1982.

NT indicates sample not tested for this constituent
INT indicates interference
CI indicates color interference

TABLE 3

Chemical Analyses*
Ground Water Monitoring Wells

Penn Central Site

| Chemical Constituent (ppm) | Well No. / Date Sample Obtained | G-132 6/25/81 | G-132 10/27/81 | G-133 6/29/81 | G-133 10/27/81 | Limit** |
|---|---|---|---|---|---|---|
| Aliphatihydrocarbons | | 1.60 | | 0.61 | | |
| C3-Benzene | | | 0.42 | | 0.80 | |
| Methylphenal | | | 8.70 | | | |
| 4-Methyl - 2- Pentanone | | 11.00 | 11.00 | | | |
| Napthalene | | 1.70 | 0.84 | | | |
| PCB's | | | 0.0024 | | 0.0046 | |
| Phenol | | | 8.90 | | | |
| Toluene | | 20.00 | 19.00 | 0.57 | 0.77 | |
| Trimethylcyclohexanol | | | 0.52 | 0.45 | 0.31 | |
| Trimethylcyclohexanone | | 2.50 | 1.80 | 1.30 | 2.60 | |
| Trimethyl-3-cyclohexene-1-methanol | | 0.96 | | | | |
| Xylenes | | 14.00 | 13.00 | 0.52 | 0.72 | |
| Alkalinity | | 750 | 3,250 | 604 | 1,740 | NE |
| Ammonia | | 41.0 | 110.0 | 20.0 | 96.0 | 1.5 |
| Arsenic | | 0.008 | 0.07 | 0.003 | 0.05 | 0.05 |
| Barium | | INT | INT | INT | INT | 1.0 |
| BOD-5 | | >2,297 | >2,167 | NT | 122 | 30.0 |
| Boron | | 2.3 | 5.7 | 1.0 | 2.8 | 1.0 |
| Cadmium | | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |
| Calcium | | 467 | 1,183 | 290 | 506 | |
| COD | | 4,550 | 11,200 | 430 | 1,000 | NE |
| Chloride | | 320 | 1,200 | 220 | 520 | 250 |
| Chromium (Cr Tot.) | | 0.02 | 0.47 | 0.00 | 0.24 | 0.05 |
| Chromium (Cr + 6) | | CI | INT | 0.00 | 0.00 | 0.05 |
| Copper | | 0.00 | 0.12 | 0.00 | 0.46 | 0.02 |
| Cyanide | | NT | NT | NT | NT | 0.025 |
| Fluoride | | 2.1 | 2.3 | 1.0 | 2.6 | 1.4 |
| Hardness | | 2,500 | 5,600 | 1,200 | 1,200 | NE |
| Iron | | 63.5 | 297.9 | 1.0 | 81.8 | 1.0 |
| Lead | | 0.00 | 0.57 | 0.00 | 0.16 | 0.05 |
| Magnesium | | 249 | 872 | 96.7 | 252 | NE |
| Manganese | | 3.56 | 6.34 | 1.06 | 2.61 | 0.15 |
| Mercury | | 0.0000 | -0.00013 | -0.00007 | NT | 0.0005 |
| Nickel | | 1.0 | 2.3 | 0.2 | 0.9 | 1.0 |
| Nitrate-Nitrite | | 0.9 | 0.0 | 0.2 | 0.0 | |
| pH (units) | | 7.9 | 6.5 | 7.2 | 7.3 | 6.5-9.0 |
| Phenolics | | 6.700 | 13.6 | 0.900 | 1.28 | |
| Phosphorus | | 0.33 | 4.4 | 0.17 | 0.69 | 0.05 |
| Potassium | | 63.3 | 160 | 26.5 | 246 | NE |
| R.O.E. (180°C) | | 5,270 | 10,600 | 2,160 | 3,200 | 500 |
| Selenium | | 0.013 | 0.04 | -0.002 | <0.01 | 0.01 |
| Silver | | 0.00 | 0.00 | 0.00 | 0.00 | 0.005 |
| Sodium | | 145 | 435 | 134 | 446 | NE |
| Specific Conductance (umhos/cm) | | 3,570 | 9,708 | 2,237 | 4,633 | NE |
| Sulfate | | 325 | 1,080 | 450 | 290 | 50 |
| Zinc | | 1.2 | 2.0 | 0.8 | 1.1 | 1.0 |

* Analyses performed by the Illinois Environmental Protection Agency.

** As submitted to STS by the Illinois Attorney General's Office January 4, 1982.

NT indicates sample not tested for this constituent
INT indicates interference
CI indicates color interference

TABLE 4

Chemical Analyses*
Soil Samples from Borings

| Chemical Constituent (ppm) | Sample No. | CS101 | CS112 | CS111 | CS110 | CS131 | CS133 | CS132 | CS102 | CS103 | CS104 | CS108 | CS117 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Boring No. | G-101 | G-102 | G-102 | G-102 | G-103 | G-103 | G-103 | G-104 | G-104 | G-105 | G-105 | G-132 |
| | Depth (ft) | 7.5-9 | 2.5-4 | 4-6 | 6-7 | 0-1.2 | 5-7 | 10-11 | 5-7 | 7.5-9 | 0-1.5 | 2.5-4.5 | 12.5-14.5 |
| Aliphatic Hydrocarbons | | 150 | 100 | 70 | 120 | 700 | 35 | 56 | 170 | 790 | | 2,100 | 47 |
| $C_3$ Benzene | | | | | | | | | 390 | 560 | | 2,600 | |
| $C_4$ Benzene | | | 57 | 12 | 19 | | | | 95 | 560 | | 1,900 | |
| $C_6$ Benzene | | | | | | | | | | 55 | | 450 | |
| Napthalene | | | | | | | | | 78 | 180 | | 710 | |
| Toluene | | 90 | | | | | | | 440 | 1,400 | | 3,100 | |
| Xylenes | | 360 | 320 | 18 | 39 | | 230 | 76 | 2,200 | 3,300 | 20 | 6,800 | |
| Ammonia | | 2.5 | 3.2 | 1.8 | 1.6 | | | | 1.2 | | | | |
| Arsenic | | <0.001 | <0.001 | <0.001 | 0.002 | | | | 0.008 | | | | |
| Barium | | 0.1 | 0.0 | 0.0 | 0.0 | | | | 0.0 | | | | |
| Boron | | 0.4 | 0.6 | 0.3 | 0.4 | | | | 0.4 | | | | |
| Cadmium | | 0.00 | 0.00 | 0.00 | 0.00 | | | | 0.00 | | | | |
| Chlorides | | 28 | 5 | 8 | 8 | | | | 15 | | | | |
| Chromium (Cr tot.) | | 0.00 | 0.00 | 0.00 | 0.00 | | | | 0.00 | | | | |
| Copper | | 0.00 | 0.00 | 0.00 | 0.00 | | | | 0.03 | | | | |
| Iron | | 0.2 | 0.0 | 0.1 | 0.2 | | | | 0.0 | | | | |
| Lead | | <0.03 | <0.03 | <0.03 | <0.03 | | | | <0.03 | | | | |
| Manganese | | 0.15 | 0.04 | 0.09 | 0.06 | | | | <0.01 | | | | |
| Mercury | | <0.05ug/l | <0.05ug/l | <0.05ug/l | <0.05ug/l | | | | <0.05ug/l | | | | |
| Nickel | | 0.0 | 0.0 | 0.0 | 0.0 | | | | 0.0 | | | | |
| pH (units) | | 7.6 | 7.9 | 7.6 | 7.9 | | | | 8.4 | | | | |
| Phenols | | 6,200 | 0.043 | 0.068 | 0.063 | | | | 0.770 | | | | |
| Phosphorus | | 0.02 | 0.02 | 0.03 | 0.03 | | | | 0.03 | | | | |
| Selenium | | <0.001 | <0.001 | <0.001 | <0.001 | | | | 0.003 | | | | |
| Sulfate | | 33.0 | 3 | 4 | 5 | | | | 135 | | | | |
| Zinc | | 0.1 | 0.1 | 0.0 | 0.0 | | | | 0.0 | | | | |

*Analyses performed by the Illinois Environmental Protection Agency.

TABLE 5

Chemical Analyses*

Surface Samples **

| Chemical Constituent (ppm) | Sample Numbers** | | | | |
|---|---|---|---|---|---|
| | CS 109 | CS 113 | CS 114 | CS 115 | CS 116 |
| Alkalinity | 850 | | | | |
| Ammonia | 1.7 | | | | |
| Arsenic | 0.007 | | | | |
| Barium | 0.2 | | | | |
| BOD-5 | 417 | | | | |
| Boron | 2.0 | | | | |
| Cadmium | 0.00 | | | | |
| Calcium | 151 | | | | |
| COD | 860 | | | | |
| Chloride | 120 | | | | |
| Chromium (CR total) | 0.04 | | | | |
| Chromium (CR + 6) | 0.00 | | | | |
| Copper | 0.04 | | | | |
| Cyanide | 0.00 | | | | |
| Fluoride | 1.7 | | | | |
| Hardness | 1000 | | | | |
| Iron | 11.3 | | | | |
| Lead | 0.12 | | | | |
| Magnesium | 182 | | | | |
| Manganese | 1.06 | | | | |
| Mercury | 0.0000 | | | | |
| Nickel | 0.2 | | | | |
| Nitrate-Nitrite | 0.0 | | | | |
| pH (units) | 8.1 | | | | |
| Phenolics | 1.000 | | | | |
| Phosphorus | 0.58 | | | | |
| Potassium | 41.2 | | | | |
| R.O.E. ($180^0$ C) | 1440 | | | | |
| Selenium | 0.004 | | | | |
| Silver | 0.00 | | | | |
| Sodium | 67.9 | | | | |
| Specific Conductance(umhos/cm) | 1470 | | | | |
| Sulfate | 12 | | | | |
| Zinc | 0.4 | | | | |
| Aliphatic Hydrocarbons | | 4,800 | 130 | 1,300 | 21,000 |
| $C_3$-Benzene | | 3,800 | 97 | | |
| $C_4$-Benzene | | 5,400 | | 270 | |
| Fatty Acid Methylesters | | 1,100 | | 980 | |
| Fatty Acids | | 830 | | 2,000 | |
| Isophorone | | | | 1,000 | |
| Methylnapthalene | | 430 | | | |
| Napthalene | | 2,200 | | 140 | |
| Phthalic Acid | | | 74 | | |
| Stearic Acid | | | 380 | | |
| Tetradecanoic Acid | 0.51 | | | | |
| Toluene | | 5,300 | 180 | 1,900 | 5,100 |
| Trimethylcyclohexanal | 0.46 | | | | |
| Trimethylcyclohexanone | 0.34 | | | | |
| Xylenes | | 4,000 | 610 | 1,500 | 4,200 |
| Sulfide | 57.[illegible] | | | | |

* Analyses performed by the Illinois Environmental Protection Agency

**Sample CS 109 - Oily residue obtained on ground surface. Light gray with solvent odor.

**Sample CS 113 - Tan, viscous fluid leaking from drum marked: DeSoto Chemical. Drum found near center of site.

**Sample CS 114 - Black, viscous fluid with no detectable odor

**Sample CS 115 - Black, viscous fluid with solvent odor.

**Sample CS 116 - Black sludge with slight solvent odor.

## Chemical Analyses*

## Samples from Test Pit Excavations**

| Chemical Constituent (ppm) | Sample Numbers** CS 125 | CS 126 | CS 127 | CS 128 | CS 129 | CS 130 |
|---|---|---|---|---|---|---|
| Aliphatic Hydrocarbons | 2,500 | 124 | 4.20 | 2,700 | | 680 |
| $C_3$-Benzene | | | | 220 | | 1,400 |
| $C_4$-Benzene | | 11 | | | | |
| Isophorone | 190 | | | | | |
| Napthalene | | 8.6 | | | | |
| Phthalic Anhydride | | | | | 2,900 | |
| Pthalates | | | | | 1,100 | 23,000 |
| Styrene | | | | 800 | | |
| Toluene | | 84 | | 1,500 | 520 | 370 |
| Trimethylcyclohexanol | | 15 | | | | |
| Trimethylcyclohexanone | | 38 | | | | |
| Xylenes | 180 | 85 | 0.63 | 1,200 | 88 | 510 |

* Analyses performed by the Illinois Environmental Protection Agency

**Sample CS 125 - Test Pit No.2 @ 6' depth (bottom of pit). Brown liquid with solvent odor.

**Sample CS 126 - Test Pit No.3 @ 4' depth (bottom of pit). Brown liquid with solvent odor.

**Sample CS 127 - Test Pit No.4 @ 4' depth - Clear liquid with black solids. Solvent odor.

**Sample CS 128 - Test Pit No.2. Sample from smashed 55-gallon drum found in test pit. Red colored semi-solid material with slight solvent odor.

**Sample CS 129 - Test Pit No.2. Sample from smashed 55-gallon drum found in test pit. Caramel colored semi-solid material with slight solvent odor.

**Sample CS 130 - Test Pit No.9. Sample from smashed 55-gallon drum found in test pit. White colored solid to semi-solid material with no odor.

TABLE 7

Illinois Pollution Control Board

Chapter 3: Water Pollution

| | Surface | | Groundwater | | Effluent | |
|---|---|---|---|---|---|---|
| | Lower Limit | Upper Limit | Lower Limit | Upper Limit | Lower Limit | Upper Limit |
| Alkalinity | NE | NE | NE | NE | NE | NE |
| Ammonia ($NH_4$) | NE | 1.5 | NE | 1.5 | NE | NE |
| Arsenic (As) | NE | 1.0 | NE | .05 | NE | .25 |
| Barium (Ba) | NE | 5.0 | NE | 1.0 | NE | 2.0 |
| BOD-5 | NE | NE | NE | 30.0 | NE | 30.0 |
| Boron (B) | NE | 1.0 | NE | 1.0 | NE | NE |
| Cadmium (Cd) | NE | .05 | NE | .01 | NE | .15 |
| COD | NE | NE | NE | NE | NE | NE |
| Chloride (Cl) | NE | 500 | NE | 250 | NE | NE |
| Chromium (Cr Tot.) | NE | NE | NE | .05 | NE | NE |
| Chromium (Cr+3) | NE | 1.0 | NE | 1.0 | NE | 1.0 |
| Chromium (Cr+6) | NE | .05 | NE | .05 | NE | .3 |
| Copper (Cu) | NE | .02 | NE | .02 | NE | 1.0 |
| Cyanide (Cn) | NE | .025 | NE | .025 | NE | .1 |
| Dissolved Oxygen | 5.0 | NE | 5.0 | NE | NE | NE |
| Fecal Coliform | NE | 400.0 | NE | 400.0 | NE | 400.0 |
| Flouride (F) | NE | 1.4 | NE | 1.4 | NE | 15.0 |
| Hardness | NE | NE | NE | NE | NE | NE |
| Iron, Total (Fe) | NE | 1.0 | NE | 1.0 | NE | 2.0 |
| Iron, Dissolved (Fe) | NE | NE | NE | .5 | NE | .5 |
| Lead (Pb) | NE | .1 | NE | .05 | NE | .1 |
| Magnesium (Mg) | NE | NE | NE | NE | NE | NE |
| Manganese (Mn) | NE | 1.0 | NE | .15 | NE | 1.0 |
| Mercury (Hg) | NE | .0005 | NE | .0005 | NE | .0005 |
| Nickel (Ni) | NE | 1.0 | NE | 1.0 | NE | 1.0 |
| Nitrate ($NO_3$) | NE | NE | NE | 10.0 | NE | NE |
| Oil | NE | NE | NE | .1 | NE | 15.0 |
| pH | 6.5 | 9.0 | 6.5 | 9.0 | 5.0 | 10.0 |
| Phenols | NE | .1 | NE | .001 | NE | .3 |
| Phsophorus (P) | NE | .05 | NE | .05 | NE | 1.0 |
| Potassium (K) | NE | NE | NE | NE | NE | NE |
| R.O.E. | NE | 1000 | NE | 500 | NE | 3500 |
| Selenium (Se) | NE | 1.0 | NE | .01 | NE | 1.0 |
| Silica (Si) | NE | NE | NE | NE | NE | NE |
| Silver (Ag) | NE | .005 | NE | .005 | NE | .1 |
| Sodium (Na) | NE | NE | NE | NE | NE | NE |
| Specific Conductance | NE | NE | NE | NE | NE | NE |
| Sulfate ($SO_4$) | NE | 500 | NE | 250 | NE | NE |
| Sulfide | NE | NE | NE | NE | NE | NE |
| Total Solids | NE | NE | NE | NE | NE | NE |
| Total Suspended Solids | NE | NE | NE | 15.0 | NE | 15.0 |
| Zinc (Zn) | NE | 1.0 | NE | 1.0 | NE | 1.0 |

## General Discussion of Chemical Results

The results for almost all samples analyzed indicate that there is significant organic and inorganic contamination of the shallow ground water at both the U.S. Scrap and the Penn Central Sites. Soil samples of the upper part of the thick clay strata which were collected during boring operations were also found to be severely contaminated. The most contaminated samples were the waste material surface samples and those samples obtained from the test pit excavations.

### Ground Water Samples

Ground water samples obtained from the U.S. Scrap Site were generally more contaminated than those collected at the Penn Central Site. However, all samples from both locations exceeded ground water limits (shown on Table 7) for ammonia, BOD-5, boron, manganese, phosphorus, R.O.E. (residue on evaporation) and sulfate. Similarly, all samples contained xylenes, toluene and several other organic solvents in varying concentrations, which are classified by RCRA as hazardous.

Concentrations of constituents found in ground water samples obtained from different monitoring wells varied considerably. This was mainly due to differences in the types of wastes which were disposed of throughout the site. The chemical odors detected and the organic constituents measured indicate that most of the wastes were solvent mixtures.

possibly from painting, degreasing or other industrial processes. These solvents are classified by RCRA (in Part 261) as being hazardous. Some of the inorganic constituents were also high but it is noteworthy that many metal concentrations were not measured at levels which exceeded acceptable standards.

There were also variations in chemical concentrations (in the same wells) of the samples collected in June and in October, 1981. October samples from the U.S. Scrap Site generally had higher concentrations for most parameters than those collected in June. Samples from the Penn Central site were more consistent with time. The changes may have been caused by seasonal water level fluctuations (possibly also influenced by the ground water mound) which changed the nature of the fill which was in contact with the water at the time of sample collection.

Soil and Fill Samples

Soil and fill samples collected above and below the prevailing water levels contained high concentrations of organic constituents and much lower levels of the more soluble inorganic compounds. This is consistent with the cohesive nature of the near surface fill and underlying natural clay which will readily adsorb most organic and some inorganic compounds. The high concentrations of organics should be of concern since they may pose a long-term environmental hazard caused by extended leaching of these contaminants into the ground water.

## Waste and Test Pit Samples

The surface waste sample analyses revealed the organic nature of most of the waste materials disposed of at the site. Extremely high concentrations of xylenes and toluene were found in most of the waste samples (hazardous under RCRA). Chlorinated hydrocarbons (PCB's) were also measured in significant amounts. Analyses of the test pit samples were consistent with these results, indicating various organic constituents in relatively high concentrations.

## Results by Boring Location

Boring G-101 (U.S. Scrap Site) - Samples obtained from this location were found to be comprised of various fill materials including a tar-like substance and some material with a brown coloration. Strong organic odors were noted in the underlying natural soil. These observations were consistent with the results which indicated a variety of organic constituents present in the ground water at concentrations greater than 1 ppm. Most notable of these were the xylenes, toluene, phenol, and aliphatic hydrocarbons. Illinois ground water standards for inorganic chemicals were exceeded by many parameters at this location. BOD-5, chloride, fluoride, iron, manganese, phosphorus and ROE were all measured at levels which exceeded the standards by at least 100% and often, by several orders of magnitude.

The soil sample analyzed from this boring was consistent with the ground water results for most of the organic constituents. Inorganic chemical concentrations were generally lower in the soil sample.

<u>Boring G-102 (U.S. Scrap Site)</u> - Paint sludge was observed in the upper part of this boring which appears to have influenced the results of the chemical analysis. Again, high concentrations of organics were measured, with xylenes and trimethylcyclohexanone having levels of 27 and 12 ppm, respectively. BOD levels were reduced, possibly due to natural toxicity in the sample, since COD levels were still significant.

Three soil boring samples were collected and analyzed at this location. The most contaminated was the uppermost soil sample, obtained from a depth of from 2.5 to 4 ft and identified as paint sludge. Concentrations of $C_4$-benzene and xylenes were lower in the underlying soil, however the aliphatic hydrocarbons were high at all depths tested. These compounds were possibly present in wastes deposited prior to the paint sludge as well as being components of the paint sludge itself.

<u>Boring G-103 (U.S. Scrap Site)</u> - Fill in this boring consisted of wood fragments underlain by a granular saturated material with a strong odor. Ground water samples obtained from this well contained the highest concentration of xylenes (120 ppm) found in any ground water sample. Other organic concentrations which exceeded 20 ppm included

aplihatic hydrocarbons, $C_4$-benzene, ethyl benzene and toluene. The COD values measured in ground water samples obtained from this well varied from 34,000 to 149,500 ppm, confirming the presence of many nonbiodegradable constituents. The alkalinity of these samples was also quite high, as were phenolics, sulfate, magnesium and many other constituents.

Only limited analyses of soil samples were performed. These indicated high levels of aliphatic hydrocarbons and xylenes in the upper soil layers.

Boring G-104 (U.S. Scrap Site)- Strong paint-like odors and a high pH level (8-10) were noted in the fill at this location. Ground water contamination levels were similar to those found in wells at G-101 and G-102. Again xylenes, toluene and trimethylcyclohexanone were measured at concentrations exceeding 20 ppm. Some additional methylated organic constituents were also measured at high levels in this location.

For the inorganic parameters in the ground water, COD values were in the 20,000 ppm range. Some metals were also analyzed at levels exceeding the standards shown on Table 7. These included zinc, selenium, nickel, arsenic, chromium, and copper. It is interesting to note that samples of tar-like fill material collected at this location contained extremely high organic concentrations (much greater than at G-101 and G-102). It appears that there is more contamination present in this material; however the constituents do not seem to be easily solubilized into the ground water.

<u>Boring G-105 (U.S. Scrap Site)</u> - The well screen at this location was placed in the bedrock aquifer at a depth of approximately 70 ft, so results of these analyses are especially critical in establishing the extent of underlying ground water contamination at this site. These results indicate that the shallow bedrock aquifer in the Silurian Dolomite has been contaminated by organic constituents. The ground water from the deep well contained xylenes in concentrations from 11-47 ppm, toluene at levels up to 26 ppm, and aliphatic hydrocarbon in amounts up to 22 ppm.

The presence of these organic constituents in G-105 probably cannot be attributed to the Revert which was used in the drilling process. Revert is a complex polysaccharide which eventually breaks down into simple sugars. The organic contaminants detected in the analysis of G-105 are generally not components of Revert.

In addition, we consider it unlikely that the bedrock aquifer has been contaminated by pollutants that leached from the shallow aquifer and through the thick layer of clay separating the two aquifers. As mentioned previously, laboratory permeability tests performed on samples of this clay indicate that it has a permeability of less than $10^{-7}$ cm/sec. With a permeability this low, seepage from the upper aquifer to the lower bedrock aquifer will be extremely slow. It is possible that the contaminants are migrating to the deep aquifer via natural fissures in the clay (highly unlikely due to the substantial thickness of the clay) or, more likely, by moving laterally in the shallow aquifer to existing water supply wells in the area and then travelling vertically down these wellholes to the deep aquifer. This would have to be substantiated however, before a final conclusion could be made.

The soil samples analyzed from this location do not relate to the ground water quality in the bedrock aquifer since they were obtained from an upper layer of red and black fill. The sample obtained from 2.5 to 4.5 feet was found to be heavily contaminated with organics. It contained almost 1% of a combination of xylenes and toluene.

<u>Boring G-106 (Background)</u> - This well was located approximately 1500 ft west of the U.S. Scrap Site as shown on Figure 1. The ground water contained 9.6 ppm of phenol and a small concentration of PCB's. Some constituents which exceeded standards included chromium, copper, iron, manganese and zinc.

No soil samples were analyzed.

<u>Boring G-132 (Penn Central Site)</u> - Various fill types were noted at two depths including wood material, a stiff clay fill and oily black cinders. The ground water contained moderate concentrations of organic constituents, most notably 4-methyl-2-pentanone, toluene, and xylenes. Phenol and methylphenol were also found at levels of approximately 9 ppm each. Ammonia concentrations were high at this location as were alkalinity, COD, chloride, sulfate and zinc.

A soil sample collected at this location (from 12.5 to 14.5 ft) contained 47 ppm of aliphatic hydrocarbons. Other organic and/or inorganic parameters were not measured. Of the two well locations on the Penn Central Site, G-132 had significantly more soil and ground water contamination than did G-133.

Boring G-133 (Penn Central Site) - This boring also encountered wood fill over a gravel material and a sandy clay fill with tar-like fluid. In general, the concentrations measured in ground water samples from this location were much lower than in ground water samples obtained from other locations. Only trimethylcyclohexanone exceeded 1 ppm. Some inorganic parameters exceeded Illinois standards but not to the extent found at any other location.

No soil samples were analyzed.

Summary of Results

The chemical data indicates that the uppermost ground water (within the fill) at both sites is severely contaminated by organic and inorganic compounds. The extent of this contamination varies, probably due to differences in waste materials placed throughout the sites. In general, the U.S. Scrap Site appears to be more contaminated than the Penn Central Site.

The ground water analyzed from the bedrock well at G-105 (at a depth of about 70 ft) was also found to contain substantial concentrations of organic and inorganic chemical constituents. While this contamination may be due to past waste disposal activities at the U.S. Scrap Site, more research and exploratory work would have to be performed to confirm this. It is unclear, based upon available information, how these chemicals entered the bedrock aquifer. As mentioned previously, the clay which separates the aquifers is thick (on the order of 55 to 60 ft) and of a low permeability ( $10^{-7}$ cm/sec).

The major type of ground water contamination throughout the two sites appears to be organic in nature, most notably, solvents such as xylenes and toluene. However, numerous other organic parameters were detected in significant quantities, indicating that overall organic contamination exists. Many inorganic constituents also exceeded Illinois standards for ground water.

Soil samples were also severely contaminated with organic compounds. Inorganic concentrations were significantly lower. It appears that the organic chemicals are being adsorbed to the soil and could, therefore, cause long-term leaching problems.

Finally, selected waste and test pit samples confirm the organic nature of the waste materials which were disposed of at the site. These samples were found to contain high concentrations of numerous organic chemicals and would generally be considered as hazardous waste materials, if the standards set forth in RCRA, Part 261 were applied.

## REMEDIAL ACTION ALTERNATIVES (Ref. 4 and 5)

Based upon the information presented in this report, it is concluded that both the U.S. Scrap and the Penn Central Sites are severely contaminated with various inorganic and organic chemical constituents. In addition, while the available data is insufficient to accurately conclude the direction of ground water flow after it exits the sites, it is also assumed that ground water is entering and leaving the site and, in doing so, is being contaminated and carrying this contamination to off-site areas.

In order to stop the flow of the contaminated uppermost ground water to off-site areas, some form of effective remedial action must be implemented at both sites. By implementing proper remedial action techniques, adverse environmental and human health impacts will be minimized (or, hopefully, eliminated). The two basic concepts which should be considered in designing and selecting the final remedial action plan are 1) to remove all of the contaminated materials from the sites or 2) to contain the contaminated ground water within the site materials rather than allow it to migrate to off-site areas.

### Removal of Contaminated Material

In evaluating the various remedial action alternatives, it may be considered advantageous to totally remove the contaminated materials from one or both of the subject sites. In deciding upon this option, the following factors should be considered from environmental, economic, and construction standpoints:

A. All waste materials (fill) must be removed from the site(s). In addition, several feet of the underlying clay must also be removed so that future movement of water through the soil will not cause leaching of contaminants and potential additional ground water contamination of the bedrock aquifer.

B. Removal and transport of the contaminated materials must be done in such a manner so as to prevent unnecessary exposure to the general public.

C. The materials must be disposed of in an environmentally safe manner. probably at a licensed landfill.

D. After the contaminated materials are removed, the site will require reclamation. The reclamation measures which will probably be necessary include:

1. Backfilling with clean soil or fill material to the surrounding ground level.

2. Providing a mechanism for surface runoff and erosion control.

3. Revegetating the site(s).

4. Consideration of post reclamation site use.

## Waste Materials Remain in Place

If it is elected to leave the contaminated materials in place, a decision must then be made whether to 1) isolate the contaminated materials by controlling surface water infiltration and off-site ground water migration or 2) treat or detoxify the ground water, fill materials, and underlying soils.

### Contaminant Isolation

If it is elected to isolate contaminated materials from the outside environment, mechanisms must be employed which will control surface water infiltration and which will preclude off-site ground water migration.

One of the primary causes of leachate generation is surface water infiltration which passes through contaminated materials and migrates downward in a contaminated state [illegible] the ground [illegible]. Therefore, reducing surface water infiltration into the contaminated materials is a prerequisite in a remedial action program designed to isolate the contaminated site materials (for that matter, this is also a prerequisite if it decided to treat the contaminated materials).

Many materials can be used to form a surface cover layer, including clay, asphalt, concrete, or other synthetic materials. Implementing one of these cover materials would also reduce the potential for contamination of surface water which runs off the U.S. Scrap and/or Penn Central Sites. It should be noted that if one of these covers is utilized, it will probably require periodic maintenance as the buried waste materials consolidate and/or degrade which would then result in differential settlements throughout the site. This could not only cause cracking or rupturing of the cover layer, but will also change the surface drainage characteristics of the site.

In addition to minimizing surface water infiltration, the cover should be designed to maximize surface runoff. By doing so, surface water will exit the site as rapidly as possible and will further help to minimize infiltration. The cover should be adequately sloped to drainage ditches which should then be designed to transport the water to nearby water courses or sewers. If a cover material is relatively impermeable and is adequate sloped, the runoff water may not require further treatment. Periodic tests should be made of this runoff water however to be sure that it contains no contaminants in excessively high concentrations.

In order to minimize the migration of contaminated ground water to off-site areas, we recommend that a seepage cutoff be installed around the entire perimeter of each site in conjunction with the surface cover. The seepage cutoff can be constructed of concrete, grout (either chemical or cement) or bentonite clay. In any case, it should be extended through the fill materials and into the underlying natural clay.

By using a combination surface cover and seepage cutoff, a completely contained unit would be formed which would be filled with contaminated waste. To monitor the effect of this unit, periodic tests of the ground water and surface water outside of the subject sites should be performed. To do this, several ground water monitoring wells will have to be installed.

Another method of halting off-site ground water migration is to excavate drainage ditches around the perimeter of the site, install drain tiles along the bottoms of the ditches (surrounded with granular material), and backfill the trenches above the drain tiles with relatively impermeable clay soils. The drain tiles would then be connected to a treatment system or a temporary holding pond. A system installed in this manner will lower the ground water table at the drainage ditch, thus reversing the ground water gradient immediately adjacent to the ditch and precluding movement of site ground water to off-site areas. These systems do require maintanence, however, as well as requiring treatment of the collected water.

In conjunction with the drainage ditch concept, the ground water in the uppermost aquifer (fill materials) could be pumped by using wellpoints and then treated before it is recharged to the ground water table. Disadvantages of this concept, however, are that it is expensive from the standpoint of pumping costs and treatment costs and also that it is technically very difficult to completely intercept the ground water before it migrates to off-site areas. The wellpoints would have to be very closely spaced in order to adequately remove all the water tending to flow between them.

In-Situ Treatment and/or Detoxification

In-situ treatment and detoxification of contaminated soils are relatively new concepts and, as such, are untried in comparison with the more common physical techniques of material removal or containment. When detoxification is performed, it is commonly done by excavating the contaminated materials, treating them above grade, and then replacing them to their original location.

Some of the more commonly used in-situ treatment techniques include water flushing, chemical reaction, physical mixing, fixation, and microbiologic activity.

Since the waste materials which were disposed of at the U.S. Scrap and Penn Central Sites span a wide variety of physical and chemical characteristics, it may not be possible to detoxify them with a single treatment method. The remedial action selection process must consider all of the treatment methods which would be required at each particular site.

## GENERAL QUALIFICATIONS

This report has been prepared in order to aid in the evaluation of the subject site and to assist the Illinois Attorney General in evaluating the subsurface contamination at the US Scrap and Penn Central Sites. The scope is limited to the specific project and locations described herein, and our description of the project represents our understanding of the significant environmental aspects and/or implications pertaining to the project as communicated to us by the Illinois Attorney General's Office. In the event that any deviations from the understood scope of work occur, STS should be informed so that changes can be reviewed and that conclusions presented in this report modified, if appropriate. Should changes in the scope of intent of the project occur without STS having the opportunity to review the changes and comment on the geotechnical or environmental consequences of the changes, STS assumes no liability for any resulting damages.

It is recommended that all construction operations resulting from recommendations presented in this report be observed by an engineer or geologist, experienced in evaluating soil-ground water systems. If you wish, STS would welcome the opportunity to provide these field services for you at the appropriate time. In addition, we would welcome the opportunity to review plans, specifications, reports and/or permits when they have been prepared so that we may have the opportunity of commenting on their effect(s) on the overall project.

The analysis and recommendations submitted in this report are based upon data obtained from soil borings performed at locations which are indicated on the location diagram and from other information as outlined in the report. This report does not reflect any variations which may occur between the boring or test pit locations; rather, specific information was obtained at the specific boring and test pit locations at specific times. It is a well-known fact that variations in soil, rock and ground water conditions can occur between such locations.

In addition, ground water monitoring wells were installed on this project. It can be expected that ground water levels may vary seasonally and annually due to precipitation, evaporation, surface runoff, and percolation. Variations of several feet are not uncommon. Therefore, interpretations made concerning the ground water characteristics using the available monitoring well readings are estimates based on the experience of the engineer, geologist, or chemist.

Chemical concentrations may also vary significantly between sampling times due to the environmental factors mentioned above and the introduction of chemicals into the soil and ground water from natural or man-made sources. Therefore, test results obtained from samples taken at discrete points in time do not provide continuous monitoring of the chemical concentrations. However, the chemical testing program performed by the Illinios Environmental Protection Agency was performed in order to systematically test the chemical content of site materials so that a reasonable engineering evaluation of the chemical concentrations and their variations could be made.

Should construction procedures be implemented after submittal of this report, unanticipated subsurface conditions may occur. For this reason, we recommend that a "Changed Conditions" clause be provided in the contract both with the general contractor and in all contracts with the sub-contractors involved in underground work. It is felt that the inclusion of this clause will permit contractors to submit lower prices because they will not need to provide as many contingencies as they normally would if equitable adjustment of changed conditions will minimize conflicts and litigation with the attendant delays and costs. Furthermore, by the immediate recognition and adjustment in contract price at the time any changed conditions are encountered, the immense problems of trying to recreate facts when litigation develops later is eliminated.

## REFERENCES


1. "Summary of the Geology of the Chicago Area" by H.B. Willman, Illinois State Geological Survey Circular 460; 1971.

2. "Preliminary Report on Ground-Water Resources of the Chicago Region, Illinois" by Max Suter, Robert E. Bergstrom, H.F. Smith, Grover H. Emrich, W.C. Walton, and T.E. Larson. Illinois State Geological Survey/Illinois State Water Survey Cooperative Ground-Water Report One; 1959.

3. United States Environmental Protection Agency, "Resource Conservation and Recovery Act: Hazardous Waste Management System", Federal Register, May 19, 1980.

4. Soil Testing Services, Inc., "Solutions to Waste Disposal Problems", Seminar Presented April 11, 1980 in Chicago, Illinois.

5. United States Environmental Protection Agency, "Closure of Hazardous Waste Surface Impoundments", SW-373, September, 1980.

# APPENDIX

# APPENDIX A

Soil Boring Logs

Standard Clause for Unanticipated Subsurface Conditions

General Notes

Procedures Regarding Field Logs, Laboratory Data Sheets & Samples

ASTM Specifications
- D-1586-67
- D-1587-67

Unified Soil Classification System

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-101 |
| **PROJECT NAME** | **ARCHITECT-ENGINEER** |
| Contamination Survey | |
| **SITE LOCATION** | |
| Lake Calumet Area, Chicago, Illinois | |

**SURFACE ELEVATION** +15.7 CCD

| SAMPLE NO. | SAMPLE TYPE | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS./FT³ | STANDARD PENETRATION BLOWS/FT |
|---|---|---|---|---|
| 1 | SS, PA | Silty clay fill, trace gravel, sand & roots -brown, gray & black (CL-Fill) | | 9 |
| 2 | SS, PA | Tar-like material, trace wood fragments -black- saturated (Fill) Strong organic odor | | 85 |
| 3 | SS | Tar-like material (sludge) -black- saturated (Fill) Strong turpentine-type odor (Geologist's observation) | | 32 |
| 4 | SS, PA | | | 7 |
| 5 | SS, RB | Tar-like material (sludge) mixed with rusty brown cinders & gravel -black & rusty brown- saturated (Fill) | | 2 |
| — | | | | 20 |
| | RB | Silty clay, trace gravel, sand and shale -gray- very stiff (CL) Slight sweet odor | | |
| 6 | ST | | 111 | * |

END OF BORING

*CALIBRATED PENETROMETER

Casing used: 10' of 4"

NOTE: See "Well Detail - G-101" for monitoring well characteristics

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN SITU THE TRANSITION MAY BE GRADUAL

| | | |
|---|---|---|
| WL 0 | WS or WD | BORING STARTED 6/22/81 |
| WL BCR | ACR | BORING COMPLETED 6/22/81 |

SOIL TESTING SERVICES, INC
111 PFINGSTEN ROAD
NORTHBROOK ILLINOIS 60062

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorny General | G-102 |
| **PROJECT NAME** | **ARCHITECT-ENGINEER** |
| Contamination Survey | |

**SITE LOCATION**
Lake Calumet Area, Chicago, Illinois

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

**SURFACE ELEVATION** +18.2 CCD

| ELEVATION / DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS./FT.³ | STANDARD PENETRATION BLOWS/FT |
|---|---|---|---|---|---|---|---|
| | | | | | "A" | | |
| | 1 | SS | | | Little gravel (Fill) | | 18 |
| | 2 | SS | | | Paint sludge | | 5/2" 16 |
| 5.0 | 3 | SS | | | Sand and cinder fill -black- medium dense (SP-Fill) | | 13 |
| | 4 | SS | | | | | 5/6" 6 |
| | | | | | Silty clay, trace gravel & sand -light brown- stiff (CL) | | 11 |
| 10.3 | 5 | SS | | | | | 25 |
| | 6 | SS | | | Silty clay, trace gravel, sand and shale -brown & gray- very stiff to hard (CL) | | 26 |
| | | RB | | | | | |
| | 7 | SS | | | Silty clay, trace gravel, sand and shale -gray- hard (CL) | | 31 |
| 15.0 | | RB | | | | | |

END OF BORING

"A" - Clayey topsoil, trace sand & roots -dark brown (OH-Fill)

Casing used: 10' of 4"

NOTE: Consistency of clay based upon Standard Penetration Tests.
See "Well Detail - G-102" for monitoring well characteristics.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

| | | | |
|---|---|---|---|
| WL 4.5 | WS or WD | BORING STARTED 6/24/81 | SOIL TESTING SERVICES, INC |
| WL | BCR ACR | BORING COMPLETED 6/24/81 | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-103 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |

SITE LOCATION

Lake Calumet Area, Chicago, Illinois

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

SURFACE ELEVATION +13.7 CCD

| ELEVATION / DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS./FT.³ | Standard penetration (blows/ft) |
|---|---|---|---|---|---|---|---|
| | 1 | SS | | | Miscellaneous fill material -dark & light brown- extr. dense (Fill) No noticeable odor | | 153/… |
| | | RB | | | | | |
| | 2 | SS | | | Gravelly fill with wood fragments -gray- medium dense (Fill) | | 22 |
| | | RB | | | | | |
| | 3 | SS | | | Granular fill saturated with fluid having a strong organic odor -black- very dense to extr. dense (Fill) | | 61 |
| | | RB | | | | | |
| | 4 | SS | | | | | 19 |
| 10.0 | | RB | | | | | |
| | 5 | SS | | | Silty clay, trace gravel, sand and shale -brown & gray with dk. gray spots - very stiff (CL) Strong chemical odor $K = 1 \times 10^{-8}$ cm/sec | | 9 |
| | | RB | | | | | |
| | 6 | ST | | | | 107 | |
| | | RB | | | | | |
| | 7 | ST | | | Silty clay, trace gravel, sand and shale -brown & partly gray- hard (CL-CH) | 109 | |
| | | RB | | | | | |
| | 8 | ST | | | | 105 | |
| | | RB | | | | | |
| | 9 | ST | | | Silty clay, trace gravel, sand and shale -gray & little brown- very stiff (CL) $K = 3 \times 10^{-7}$ cm/sec | 111 | |

END OF BORING

*CALIBRATED PENETROMETER

NOTE: See "Well Detail - G-103" for monitoring well characteristics

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

| WL | WS or WD | BORING STARTED 5/26/81 | SOIL TESTING SERVICES, INC |
|---|---|---|---|
| WL BCR | ACR | BORING COMPLETED 5/26/81 | … PFINGSTEN ROAD NORTHBROOK, ILLINOIS 60062 |

RIG … FOREMAN … APP'D BY … JOB NO. …

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-104 |
| **PROJECT NAME** | **ARCHITECT-ENGINEER** |
| Contamination Survey | |

**SITE LOCATION**
Lake Calumet Area, Chicago, Illinois

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

**SURFACE ELEVATION** +15.7 CCD

| ELEVATION | DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS./FT.³ | STANDARD PENETRATION BLOWS/FT |
|---|---|---|---|---|---|---|---|---|
| | | 1 | SS | | | "A" | | |
| | | 1A | | | | "B" | | |
| | | 1B | | | | Tar-like material (sludge),-trace gravel, wood & brick (Fill) Strong paint odor | | |
| | | 2 | SS | | | | | 58 |
| | | | PA | | | | | |
| | 5.0 | 3 | SS | | | Sandy & gravelly fill material, trace brick & wood -black & gray- very dense (Fill) Strong paint odor (pH = 9 to 10) | | 21 |
| | | | PA | | | | | |
| | | 4 | SS | | | Sandy tar-like fill material -black & gray- med. dense - saturated at 6 ft (Fill) Strong turpentine odor | | 11 |
| | 10.0 | | PA | | | | | 6 |
| | | 5 | SS | | | Silty clay, trace gravel & sand -brown & gray- very stiff (CL) Slight paint odor - Consistency based on Standard Penetration Test | | 18 |
| | | | RB | | | | | |
| | | | RB | | | Silty clay, trace gravel, sand and shale -gray- very stiff (CL) | | |
| | 15.0 | | | | | | | |
| | | 6 | ST | | | | 111 | |

END OF BORING

*CALIBRATED PENETROMETER

"A" - Clayey topsoil, trace wood, slag & paint residue (Fill)
Paint-like odor

"B" - Sandy and gravelly fill material (Fill)
Strong paint-like odor (pH = 8 to 9)

Casing used: 10' of 4"

NOTE: See "Well Detail - G-104" for monitoring well characteristics.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU, THE TRANSITION MAY BE GRADUAL

| | | |
|---|---|---|
| WL 6' WS or WD | BORING STARTED 6/20/81 | SOIL TESTING SERVICES, INC. 111 PFINGSTEN ROAD |
| WL BCR ACR | BORING COMPLETED 6/22/81 | NORTHBROOK ILLINOIS 60062 |

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-105 (cont.) |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |

SITE LOCATION
Lake Calumet Area, Chicago, Illinois

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5
PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50
STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50

| ELEVATION DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT LBS./FT.³ | |
|---|---|---|---|---|---|---|---|
| 37.0 | | | | | Continued from Previous Page | | |
| | | FT | | | Silty clay, little sand, trace gravel & shale -gray- hard (CL) | | |
| 40.0 | | | | | $K = 2 \times 10^{-8}$ cm/sec | | |
| | 12 | ST | | | | | 7 |
| | | FT | | | | | |
| 45.0 | 13 | ST | | | | 125 | 6 |
| | | FT | | | | | |
| 50.0 | | | | | | | |
| | 14 | SS | | | | | 10 2 |
| 55.0 | | FT | | | | | 12 2 |
| | 15 | SS | | | | | |
| | | FT | | | | | |
| 60.0 | 16 | SS | | | Clayey silt, trace gravel, sand and shale -gray- extr. dense - moist (ML) | | 15 2 |
| | | FT | | | | | |
| 65.0 | | SS | | | Broken bedrock and/or boulders. NOTE: Revert used at 66 ft to stop cave-in. | | |
| | | PB | | | Limestone bedrock | | |
| 70.0 | | | | | END OF BORING | *CALIBRATED PENETROMETER | |
| | | | | | Continued on Next Page | | |

**OWNER:** Illinois Attorney General

**LOG OF BORING NUMBER:** G-106

**PROJECT NAME:** Contamination Survey

**ARCHITECT-ENGINEER:**

**SITE LOCATION:** Lake Calumet Area, Chicago, Illinois

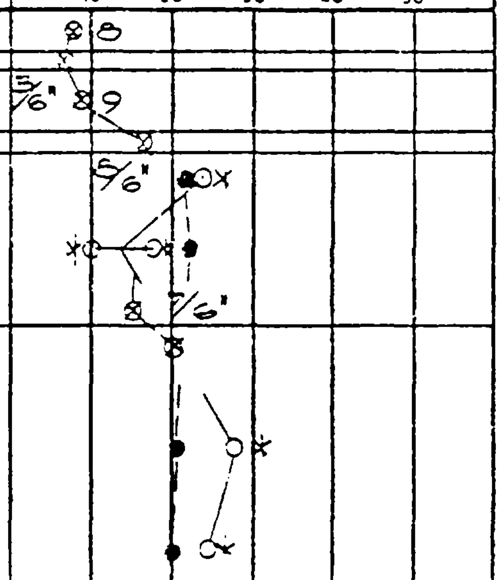
UNCONFINED COMPRESSIVE STRENGTH TONS/FT$^2$: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50

**SURFACE ELEVATION** +9.9 CCD

| ELEVATION / DEPTH | SAMPLE NO. | SAMPLE TYPE | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS./FT.$^3$ |
|---|---|---|---|---|
| | 1 | SS | Granular fill -black (Fill) | |
| | 1A | | Med. to coarse sand -rust (SP) | |
| | 2 | SS | "A" | |
| | | | Med. to coarse sand -rust (SP) | |
| | 2A | | | |
| 5.0 | 3 | ST | | 110 |
| | 4 | ST | Silty clay, trace gravel, sand, shale & gypsum crystals -brown & gray- stiff to very stiff (CL) | |
| | | PA | | |
| | 5 | SS | | |
| | 5A | | Silty clay, trace gravel, sand and shale -gray- very stiff (CL) | |
| 10.0 | | PA | $K = 3 \times 10^{-8}$ cm/sec | |
| | 6 | ST | | 113 |
| | | PA | | |
| | 7 | ST | | 107 |
| 14.5 | | | END OF BORING | |




*CALIBRATED PENETROMETER

"A" - Silty clay, little topsoil -brown, gray and black (CL)

NOTE: See "Well Detail -G-106" for monitoring well characteristics

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES; IN SITU THE TRANSITION MAY BE GRADUAL

| | | | |
|---|---|---|---|
| WL 2' | WS or WD | BORING STARTED 6/26/81 | SOIL TESTING SERVICES, INC. |
| WL BCR | ACR | BORING COMPLETED 6/26/81 | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-133 |
| **PROJECT NAME** | **ARCHITECT-ENGINEER** |
| Contamination Survey | |
| **SITE LOCATION** | |
| Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT 2 — 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % — 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT — 10 20 30 40 50

SURFACE ELEVATION +17.4 CCD

| ELEVATION / DEPTH | SAMPLE NO. | SAMPLE TYPE | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT 3 | STANDARD PENETRATION BLOWS/FT |
|---|---|---|---|---|---|
| | 1 | SS | Clayey topsoil, little wood, trace roots -dk. brown (OH-Fill) | | 18 |
| | | PP | | | |
| | 2 | SS | Saturated wood fragments -black- (Fill) Sample 3: not recovered | | 70 |
| | | RB | | | |
| | 3 | SS | | | 6 |
| | | RB | Gravel fill -light gray- extr. dense - saturated (GP-Fill) Very high pH level | | |
| | 4 | SS | | | 140/4" |
| | | RB | | | |
| 10.0 | | RB | | | |
| | 5 | SS | Sandy clay fill (slightly tar-like), trace wood, gravel & roots -black- very stiff (Fill) Paint odor | | 16 |
| | | BH | | | |
| | 6 | SS | Silty clay, trace gravel, sand and shale -brown, gray & black- stiff to very stiff (CL) Paint odor | | 11 |
| 15.0 | | RB | | | 10/6" |
| | 7 | SS | Silty clay, trace gravel, sand and shale -grayish brown- stiff (CL) Slight paint odor | | 11 |
| | | RB | | | |
| | 8 | SS | | | 28 |
| 20.0 | | RB | Silty clay, trace gravel, sand and shale -grayish brown- very stiff to hard (CL) | | 16/6" |
| | 9 | SS | | | 27 |
| | | RB | Silty clay, trace gravel, sand and shale -brownish gray- very stiff to hard (CL) | | |
| | 10 | SS | | | 71/2" |

END OF BORING

NOTE: Consistencies of clay based on Standard Penetration Tests
See "Well Detail - G-133" for monitoring well characteristics.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN SITU THE TRANSITION MAY BE GRADUAL

| | |
|---|---|
| WL [illegible] WS or WD | BORING STARTED [illegible] |
| WL BCR ACR | BORING COMPLETED [illegible] |
| RIG [illegible] FOREMAN [illegible] | APP'D BY [illegible] STS JOB NO. [illegible] |

SOIL TESTING SERVICES, INC
111 PFINGSTEN ROAD
NORTHBROOK ILLINOIS 60062

| OWNER<br>Illinois Attorney General | LOG OF BORING NUMBER<br>G-132 |
|---|---|
| PROJECT NAME<br>Contamination Survey | ARCHITECT-ENGINEER |
| SITE LOCATION<br>Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT²: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50

SURFACE ELEVATION +19.8 CCD

| SAMPLE NO. | SAMPLE TYPE | DESCRIPTION OF MATERIAL | STANDARD PENETRATION (BLOWS/FT) |
|---|---|---|---|
| 1 | SS | Sandy & gravelly fill (crushed stone) -lt. gray- medium dense to very dense (Fill) Very high pH level | 71 |
| 2 | SS | | 26 |
| 3 | SS | Wood - no sample recovered | 47 |
| 4 | SS | | 49 |
| 4A | | Clayey fill, trace gravel, sand and wood -black & gray- very stiff - Very strong paint odor | 21 |
| 5 | SS | | 22 |
| 5A | | | 19 |
| 6 | SS | Oily cinder fill -black- medium dense - saturated with oil | 27 |
| 7 | SS | Silty organic clay -black- stiff to very stiff (OH) | 14 |
| 7A | | | 19 |
| 8 | SS | Silty clay, trace gravel, sand and shale -brown & gray- very stiff (CL) | 24 |
| 9 | SS | | 16 |
| 10 | SS | Silty clay, trace gravel, sand and shale -gray- hard (CL) | 27 |
| 11 | SS | | 39 |

END OF BORING

NOTE: Obstruction encountered at 4.5 ft. Boring reset 5 ft south. Consistencies of clay based on Standard Penetration Test. See "Well Detail -G-132" for monitoring well characteristics.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

| W.L. | WS or WD | BORING STARTED 6/25/81 | SOIL TESTING SERVICES, INC.<br>111 PFINGSTEN ROAD<br>NORTHBROOK ILLINOIS 60062 |
|---|---|---|---|
| W.L. BCR | ACR | BORING COMPLETED 6/25/81 | |
| W.L. | | RIG ... FOREMAN ... | APP'D BY ... STS JOB NO. ... |

<u>Standard Clause for Unanticipated Subsurface Conditions</u>

"The owner has had a subsurface investigation performed by a foundation consultant, the results of which are contained in the consultant's report. The consultant's report presents his conclusions on the subsurface conditions based on his interpretation of the data obtained in the investigation. The contractor acknowledges that he has reviewed the consultant's report and any addenda thereto, and that his bid for earthwork operations is based on the subsurface conditions, as described in that report. It is recognized that a subsurface investigation may not disclose all conditions as they actually exist and further, conditions may change, particularly groundwater conditions, between the time of a subsurface investigation and the time of earthwork operations. In recognition of these facts, this clause is entered in the contract to provide a means of equitable additional compensation for the contractor if adverse unanticipated conditions are encountered and to provide a means of rebate to the owner if the conditions are more favorable than anticipated.

At any time during earthwork, paving and foundation construction operations that the contractor encounters conditions that are different than those anticipated by the foundation consultant's report, he shall immediately (within 24 hours) bring this fact to the owner's attention. If the owner's representative on the construction site observes subsurface conditions which are different than those anticipated by the foundation consultant's report, he shall immediately (within 24 hours) bring this fact to the contractor's attention. Once a fact of unanticipated conditions has been brought to the attention of either the owner or the contractor, and the consultant has concurred, immediate negotiations will be undertaken between the owner and the contractor to arrive at a change in contract price for additional work or reduction in work because of the unanticipated conditions. The contractor agrees that the following unit prices would apply for additional or reduced work under the contract. For changed conditions for which unit prices are not provided, the additional work shall be paid for on a time and material basis."

Another example of a changed conditions clause can be found in paper No. 4035 by Robert F. Borg published in ASCE Construction Division Journal, No. CO2, September 1964, page 37.

# GENERAL NOTES

## DRILLING & SAMPLING SYMBOLS:

| | | | |
|---|---|---|---|
| SS : | Split Spoon - 1 3/8" I.D., 2" O.D. Unless otherwise noted | OS : | Osterberg Sampler - 3" Shelby Tube |
| ST : | Shelby Tube - 2" O.D., Unless otherwise noted | HS : | Hollow Stem Auger |
| PA : | Power Auger | WS : | Wash Sample |
| DB : | Diamond Bit - NX, BX, AX | FT : | Fish Tail |
| AS : | Auger Sample | RB : | Rock Bit |
| JS : | Jar Sample | BS : | Bulk Sample |
| VS : | Vane Shear | PM : | Pressuremeter Test, In-Situ |
| | | GS : | Giddings Sampler |

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

## WATER LEVEL MEASUREMENT SYMBOLS:

| | | | |
|---|---|---|---|
| WL : | Water Level | WCI : | Wet Cave In |
| WS : | While Sampling | DCI : | Dry Cave In |
| WD : | While Drilling | BCR : | Before Casing Removal |
| AB : | After Boring | ACR : | After Casing Removal |

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of ground water elevations may not be possible, even after several days of observations; additional evidence of ground water elevations must be sought.

## GRADATION DESCRIPTION & TERMINOLOGY:

Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays or clayey silts if they are cohesive and silts if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

| Major Component Of Sample | Size Range | Descriptive Term Of Components Also Present in Sample | Percent Of Dry Weight |
|---|---|---|---|
| Boulders | Over 8 in. (200 mm) | Trace | 1 - 9 |
| Cobbles | 8 inches to 3 inches (200 mm to 75 mm) | Little | 10 - 19 |
| Gravel | 3 inches to #4 sieve (75 mm to 4.76 mm) | Some | 20 - 34 |
| Sand | #4 to #200 sieve (4.76 mm to 0.074 mm) | And | 35 - 50 |
| Silt | Passing #200 sieve (0.074 mm to 0.005 mm) | | |
| Clay | Smaller than 0.005 mm | | |

## CONSISTENCY OF COHESIVE SOILS:

| Unconfined Compressive Strength, Qu, tsf | Consistency |
|---|---|
| < 0.25 | Very Soft |
| 0.25 - 0.49 | Soft |
| 0.50 - 0.99 | Medium (Firm) |
| 1.00 - 1.99 | Stiff |
| 2.00 - 3.99 | Very Stiff |
| 4.00 - 8.00 | Hard |
| > 8.00 | Very Hard |

## RELATIVE DENSITY OF GRANULAR SOILS:

| N - Blows per ft. | Relative Density |
|---|---|
| 0 - 3 | Very Loose |
| 4 - 9 | Loose |
| 10 - 29 | Medium Dense |
| 30 - 49 | Dense |
| 50 - 80 | Very Dense |
| 80- | Extremely Dense |

## PROCEDURES REGARDING FIELD LOGS,

## LABORATORY DATA SHEETS AND SAMPLES

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering.

Specifically, field logs are prepared during performance of the drilling and sampling operations which are intended to portray essentially field occurrences, sampling locations and other information.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by more experienced soil engineers, and differences between the field logs and the final logs exist.

The engineer preparing the report reviews the field and laboratory logs, classifications and test data, and in his judgement in interpreting this data, may make further changes.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then destroyed unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, an inspection of these samples should recognize this factor.

It is common practice in the soil and foundation engineering profession that field logs and laboratory data sheets not be included in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. On the other hand, we are aware that perhaps certain contractors and subcontractors submitting bids or proposals on work might have an interest in studying these documents before submitting a bid or proposal. For this reason, the field logs will be retained in our office for inspection by all contractors submitting a bid or proposal. We would welcome the opportunity to explain any changes that have and typically are made in the preparation of our final reports, to the contractor or subcontractors, before the firm submits its bid or proposal, and to describe how the information was obtained to the extent the contractor or subcontractor wishes. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

The descriptive terms and symbols used on the logs are described on the attached sheet, entitled, General Notes.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

1916 Race St., Philadelphia, Pa. 19103

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# *Standard Method for*

# PENETRATION TEST AND SPLIT-BARREL SAMPLING OF SOILS[1]

ASTM Designation: D 1586 – 67

This Standard of the American Society for Testing and Materials is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

## 1. Scope

1.1 This method describes a procedure for using a split-barrel sampler to obtain representative samples of soil for identification purposes and other laboratory tests, and to obtain a measure of the resistance of the soil to penetration of the sampler.

## 2. Apparatus

2.1 *Drilling Equipment*—Any drilling equipment shall be acceptable that provides a reasonably clean hole before insertion of the sampler to ensure that the penetration test is performed on undisturbed soil, and that will permit the driving of the sampler to obtain the sample and penetration record in accordance with the procedure described in 3. Procedure. To avoid "whips" under the blows of the hammer, it is recommended that the drill rod have a stiffness equal to or greater than the A-rod. An "A" rod is a hollow drill rod or "steel" having an outside diameter of $1\frac{5}{8}$ in. or 41.2 mm and an inside diameter of $1\frac{1}{8}$ in. or 28.5 mm, through which the rotary motion of drilling is transferred from the drilling motor to the cutting bit. A stiffer drill rod is suggested for holes deeper than 50 ft (15 m). The hole shall be limited in diameter to between $2\frac{1}{4}$ and 6 in. (57.2 and 152 mm).[2]

2.2 *Split-Barrel Sampler*—The sampler shall be constructed with the dimensions indicated in Fig. 1. The drive shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The coupling head shall have four $\frac{1}{2}$-in. (12.7-mm) (minimum diameter) vent ports and shall contain a ball check valve. If sizes other than the 2-in. (50.8-mm) sampler are permitted, the size shall be conspicuously noted on all penetration records.

2.3 *Drive Weight Assembly*—The assembly shall consist of a 140-lb (63.5-kg) weight, a driving head, and a guide permitting a free fall of 30 in. (0.76 m). Special precautions shall be taken to ensure that the energy of the falling weight is not reduced by friction between the drive weight and the guides.

2.4 *Accessory Equipment*—Labels, data sheets, sample jars, paraffin, and other necessary supplies should accompany the sampling equipment.

## 3. Procedure

3.1 Clean out the hole to sampling elevation using equipment that will ensure that the material to be sampled is not disturbed by the operation. In saturated sands and silts withdraw the drill bit slowly to prevent loosening of the soil around the hole. Maintain the water level in the hole at or above ground water level.

3.2 In no case shall a bottom-discharge bit be permitted. (Side-discharge bits are permissible.) The process of jetting through an open-tube sampler and then sampling when the desired depth is reached shall not be permitted. Where casing is used, it may not be driven below sampling elevation. Record any loss of circulation or excess pressure in drilling fluid during advancing of holes.

3.3 With the sampler resting on the bottom of the hole, drive the sampler with blows from the 140-lb (63.5-kg) hammer falling 30 in. (0.76 m) until either 18 in. (0.45 m) have been penetrated or 100 blows have been applied.

3.4 Repeat this operation at intervals not longer than 5 ft (1.5 m) in homogeneous strata and at every change of strata.

3.5 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fractions thereof. The first 6 in. (0.15 m) is considered to be a seating drive. The number of blows required for the second and third 6 in. (0.15 m) of penetration added is termed the penetration resistance, *N*. If the sampler is driven less than 18 in. (0.45 m), the penetration resistance is that for the last 1 ft (0.30 m) of penetration. If less than 1 ft (0.30 m) is penetrated, the logs shall state the number of blows and the fraction of 1 ft (0.30 m) penetrated.

3.6 Bring the sampler to the surface and open. Describe carefully typical

[1] Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee D-18 on Soil and Rock for Engineering Purposes. A list of members may be found in the ASTM Year Book.

Current edition accepted Oct. 20, 1967. Originally issued 1958. Replaces D 1586 – 64 T.

[2] Hvorslev, M. J., *Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes*, The Engineering Foundation, 345 East 47th St., New York, N. Y. 10017.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

1916 Race St., Philadelphia, Pa. 19103

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*Standard Method for*

# THIN-WALLED TUBE SAMPLING OF SOILS[1]

ASTM Designation: D 1587 – 67

This Standard of the American Society for Testing and Materials is issued under the fixed designation D 1587; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

## 1. Scope

1.1 This method describes a procedure for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests. It is intended as a guide to more complete specifications to meet the needs of a particular job.

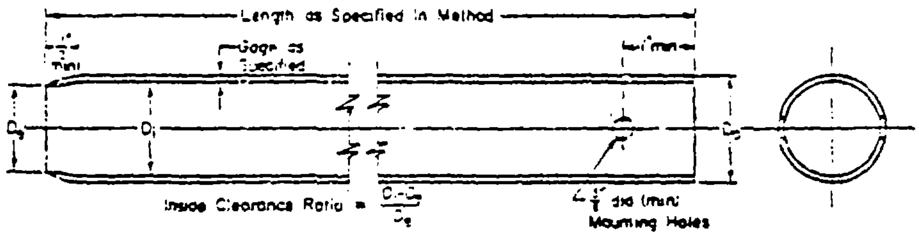
1.2 There are, in general, two types of samplers that use thin-walled tubes for sampling, namely, open-tube samplers, and piston samplers.[2] In general, piston samplers are better and can be used in almost all soils. Since the thin-walled tube requirements are the same for both types of samplers, the method described applies equally to both.

## 2. Apparatus

2.1 *Drilling Equipment*—Any drilling equipment may be used that provides a reasonably clean hole before insertion of the thin-walled tube; that does not disturb the soil to be sampled, and that can effect continuous and rapid penetration of the tube into the sampled soil.

2.2 *Thin-Walled Tubes*—Thin-walled tubes 2 to 5 in. (50.8 to 127 mm) in outside diameter and made of any materials having adequate strength and resistance to corrosion will be satisfactory (Fig. 1). Adequate resistance to corrosion can be provided by a suitable coating. Sizes other than these may be used, if specified.

2.2.1 Tubes shall be of such a length that between five and ten times the diameter is available for penetration into sands and between ten and fifteen diameters is available for penetration into clays. Tubes shall be round and smooth, without bumps, dents, or scratches. They shall be clean, and free from rust and dirt. Seamless or welded tubes are permissible, but welds must not project at the seam. The cutting edge shall be machined as shown in Fig. 1 and shall be free from




NOTE 1—Minimum of two mounting holes on opposite sides for 2 to 3½ in. sampler.
NOTE 2—Minimum of four mounting holes spaced at 90 deg for samplers 4 in. and larger.
NOTE 3—Tube held with hardened screws.

TABLE OF METRIC EQUIVALENTS

| in. | mm | cm |
|---|---|---|
| 1/4 | 6.77 | ... |
| 1/2 | 12.7 | 1.27 |
| 1 | 25.4 | 2.54 |
| 2 | ... | 5.08 |
| 3½ | ... | 8.89 |
| 4 | ... | 10.16 |

FIG. 1—Thin-Walled Tube for Sampling.

TABLE 1—SUITABLE THIN-WALLED STEEL SAMPLE TUBES[a]

| | | | |
|---|---|---|---|
| Outside diameter: | | | |
| in. | 2 | 3 | 5 |
| mm | 50.8 | 76.2 | 127 |
| Wall thickness: | | | |
| Bwg | 18 | 16 | 11 |
| in. | 0.049 | 0.065 | 0.120 |
| mm | 1.24 | 1.65 | 3.05 |
| Tube length: | | | |
| in. | 36 | 36 | 54 |
| m | 0.91 | 0.91 | 1.45 |
| Clearance ratio, | | | |
| per cent | 1 | 1 | 1 |

[a] The three diameters recommended in Table 1 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions.

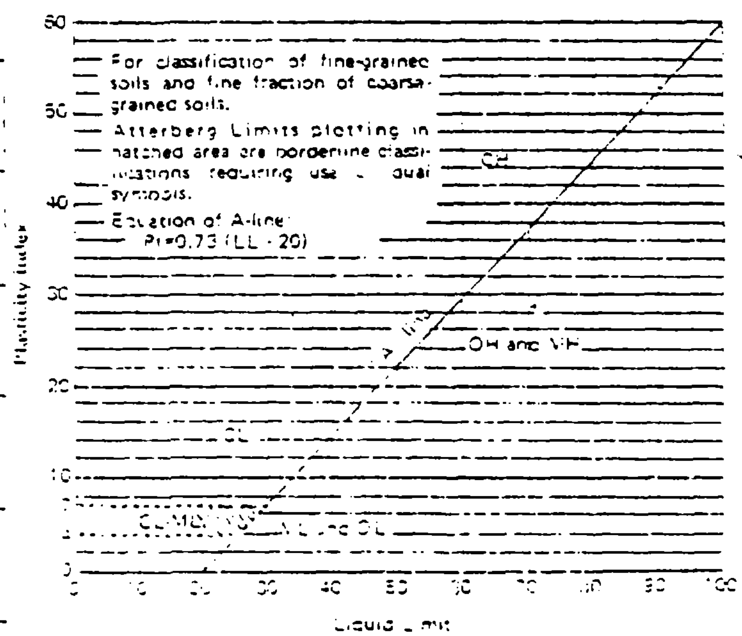
[1] Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee D-18 on Soil and Rock for Engineering Purposes. A list of members may be found in the ASTM Year Book.

Current edition issued Oct. 20, 1967. Originally issued 1958. Replaces D 1587 – 58 T.

[2] Hvorslev, M. J., *Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes*, The Engineering Foundation, 345 East 47th St., New York, N. Y. 10017.

# UNIFIED SOIL CLASSIFICATION SYSTEM

| Major divisions | | | Group symbols | Typical names | | Laboratory classification criteria | |
|---|---|---|---|---|---|---|---|
| Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size) | Gravels (More than half of coarse fraction is larger than No. 4 sieve size) | Clean gravels (Little or no fines) | GW | Well-graded gravels, gravel-sand mixtures, little or no fines | Determine percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse grained soils are classified as follows: Less than 5 per cent ... GW, GP, SW, SP; More than 12 per cent ... GM, GC, SM, SC; 5 to 12 per cent ... *Borderline* cases requiring dual symbols | $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 | |
| | | | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines | | Not meeting all gradation requirements for GW | |
| | | Gravels with fines (Appreciable amount of fines) | GM (d / u) | Silty gravels, gravel-sand-silt mixtures | | Atterberg limits below "A" line or P.I. less than 4 | Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols |
| | | | GC | Clayey gravels, gravel-sand-clay mixtures | | Atterberg limits above "A" line with P.I. greater than 7 | |
| | Sands (More than half of coarse fraction is smaller than No. 4 sieve size) | Clean sands (Little or no fines) | SW | Well-graded sands, gravelly sands, little or no fines | | $C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 | |
| | | | SP | Poorly graded sands, gravelly sands, little or no fines | | Not meeting all gradation requirements for SW | |
| | | Sands with fines (Appreciable amount of fines) | SM (d / u) | Silty sands, sand-silt mixtures | | Atterberg limits below "A" line or P.I. less than 4 | Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols. |
| | | | SC | Clayey sands, sand-clay mixtures | | Atterberg limits above "A" line with P.I. greater than 7 | |
| Fine-grained soils (More than half of material is *smaller* than No. 200 sieve) | Silts and clays (Liquid limit less than 50) | | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity | | | |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays | | | |
| | | | OL | Organic silts and organic silty clays of low plasticity | | | |
| | Silts and clays (Liquid limit greater than 50) | | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts | | | |
| | | | CH | Inorganic clays of high plasticity, fat clays | | | |
| | | | OH | Organic clays of medium to high plasticity, organic silts | | | |
| Highly organic soils | | | Pt | Peat and other highly organic soils | | | |




Plasticity Chart

# APPENDIX B

Monitoring Well Diagrams

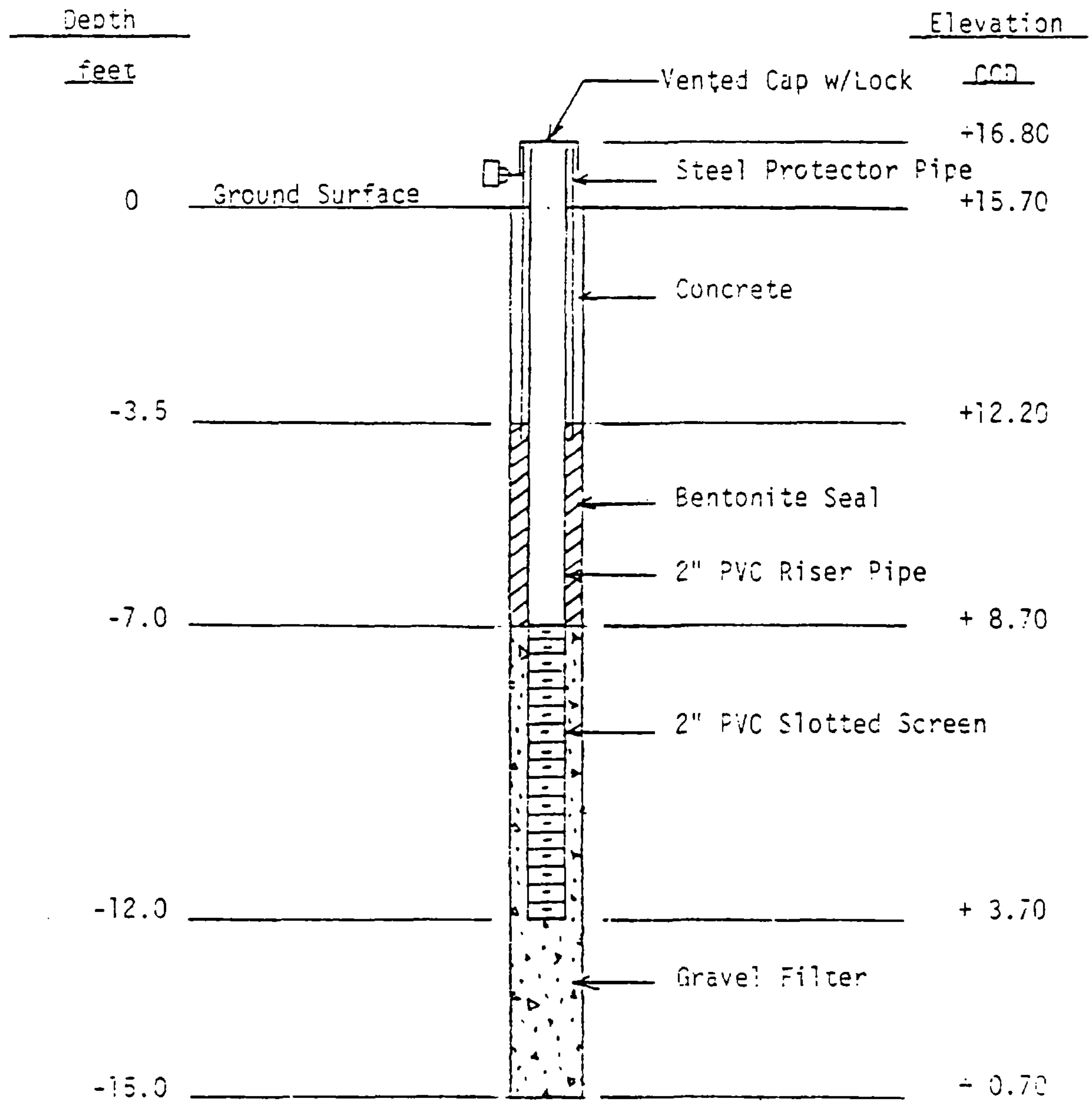
SOIL TESTING SERVICES, INC.

DATE 7/27/81 | PAGE ___ OF ___

CLIENT Illinois Attorney General | STS JOB NO 22063 | BY MGS | CHK ___

WELL DETAIL

G-101

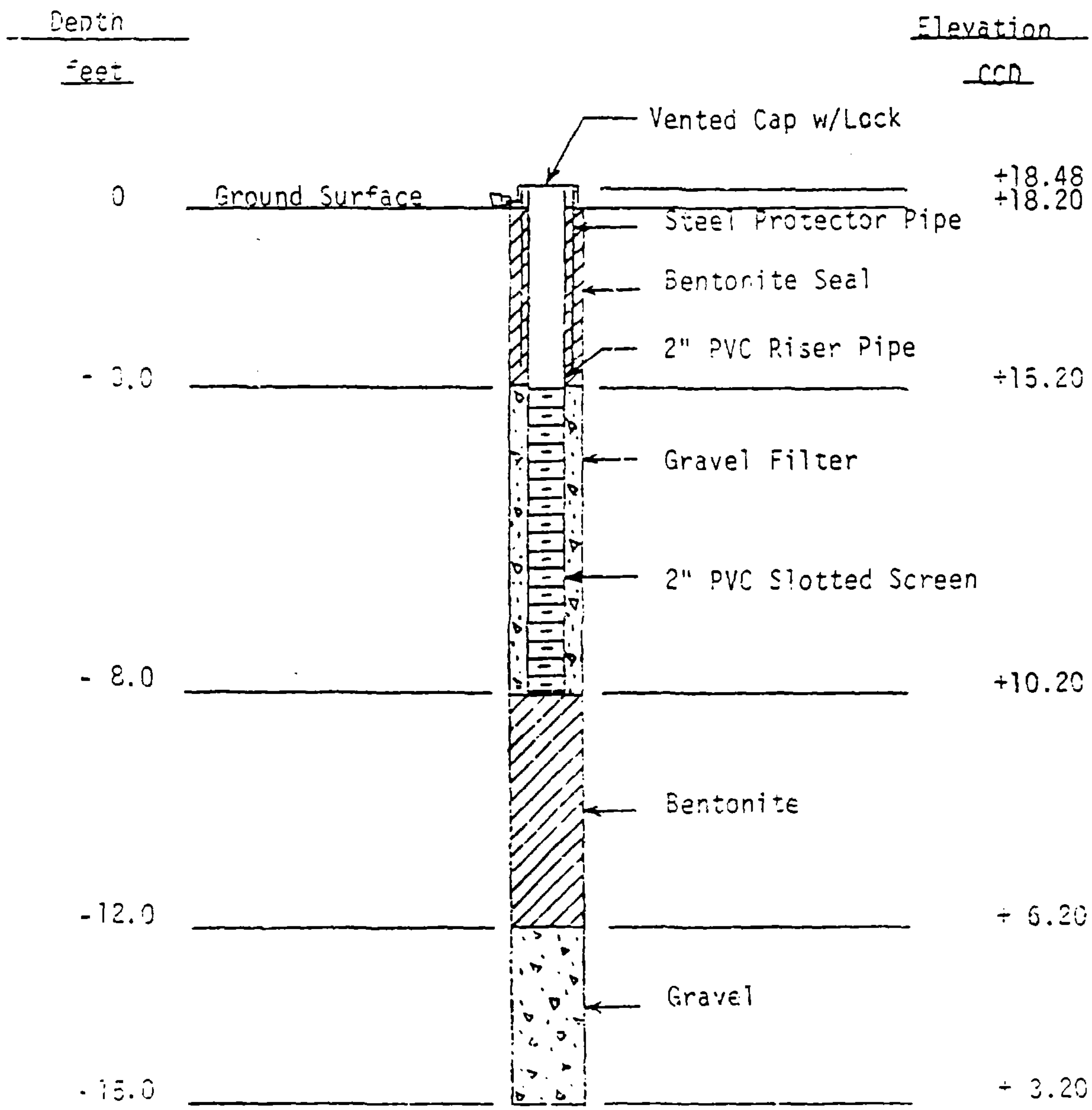


SOIL TESTING SERVICES, INC. | DATE 7/27/81 | PAGE ___ OF ___

CLIENT Illinois Attorney General | STS JOB NO 22063 | BY MGS | CHK ___

WELL DETAIL

G-102



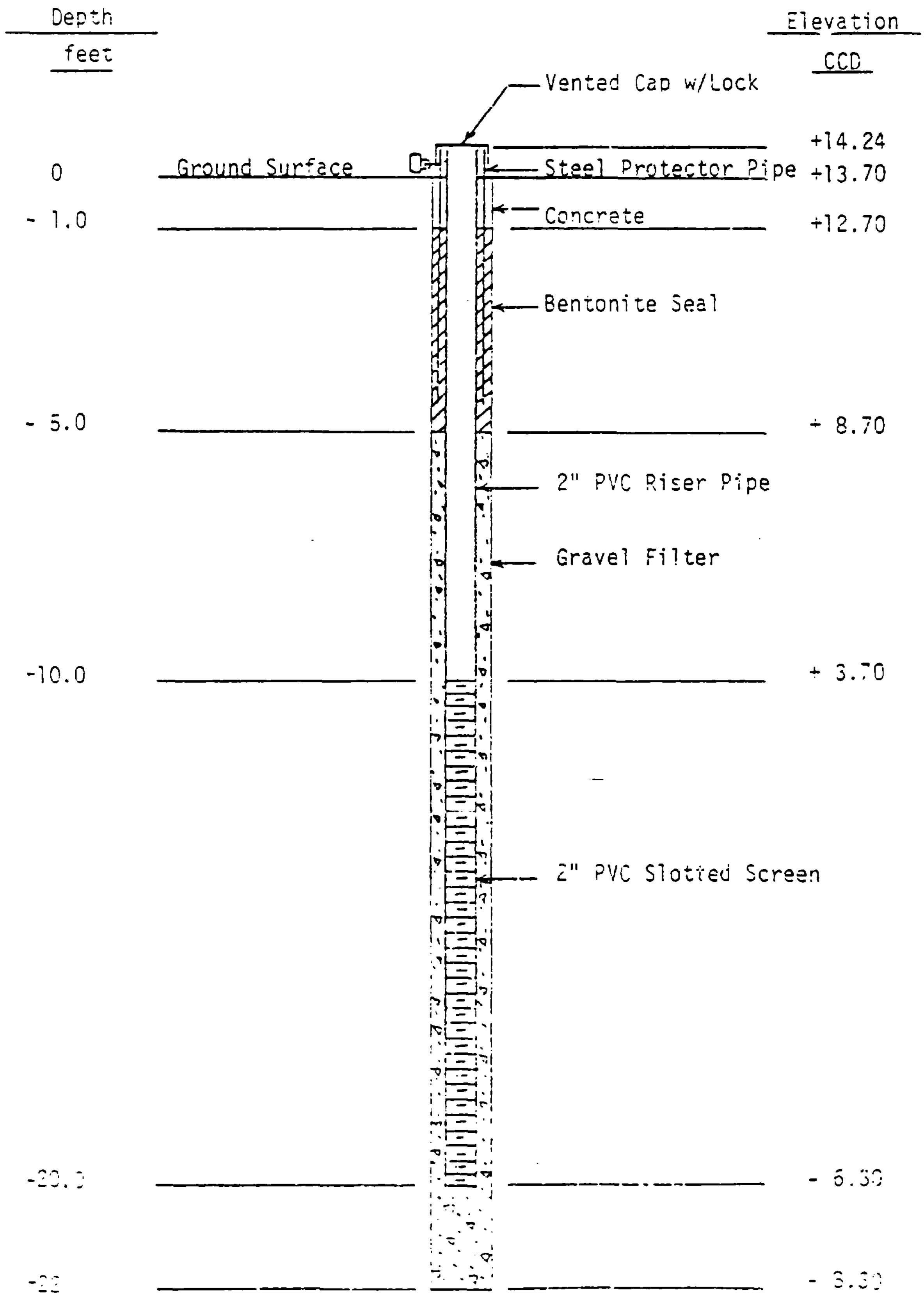
SOIL TESTING SERVICES, INC.

DATE 7/27/81 | PAGE ___ OF ___

CLIENT Illinois Attorney General STS JOB NO 22063 | BY MGS | CHK ___

WELL DETAIL

G-103



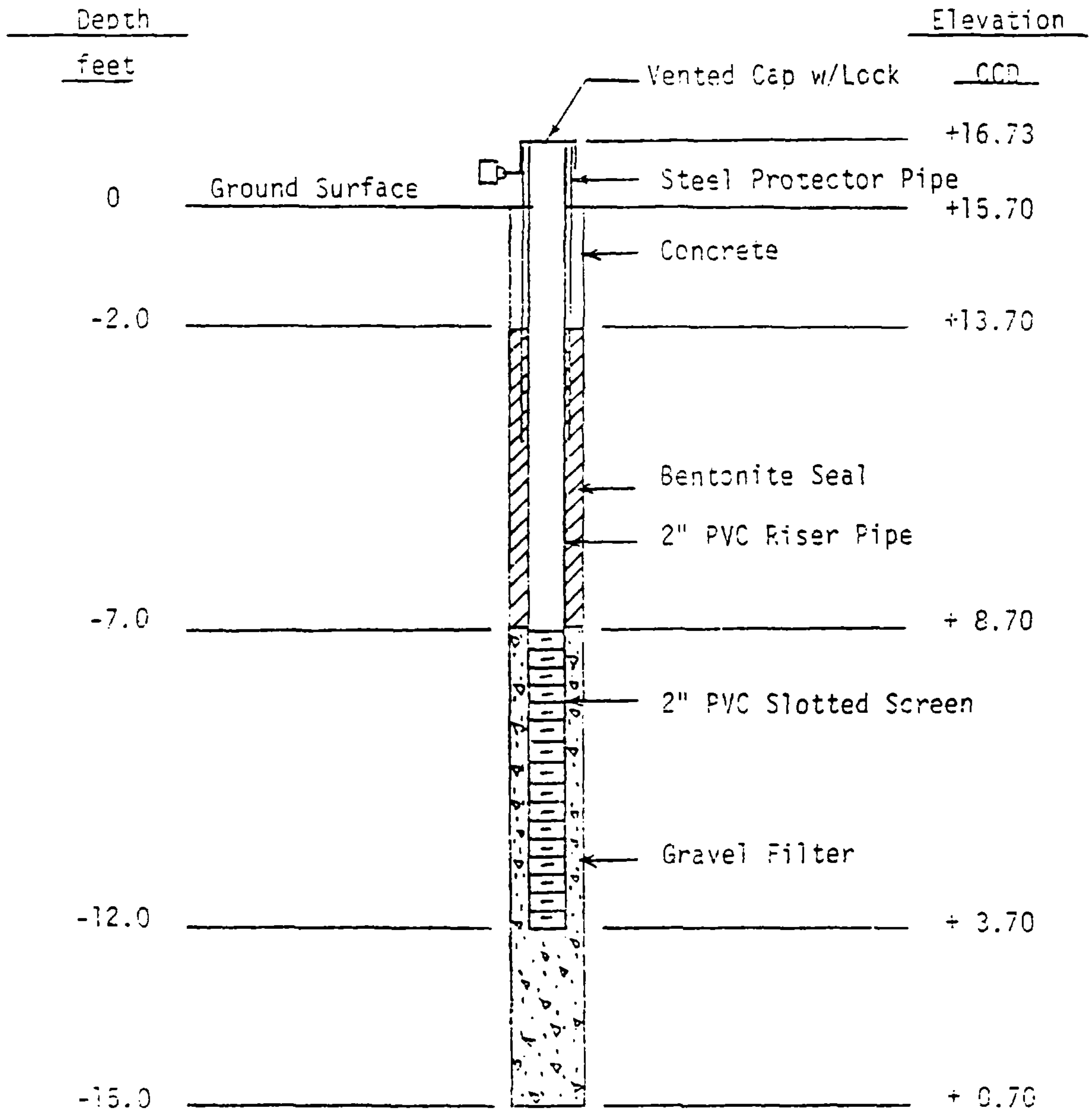
SOIL TESTING SERVICES, INC.

DATE 7/27/81 PAGE ___ OF ___

CLIENT Illinois Attorney General STS JOB NO 22063 BY MGS CHK ___

WELL DETAIL

G-104

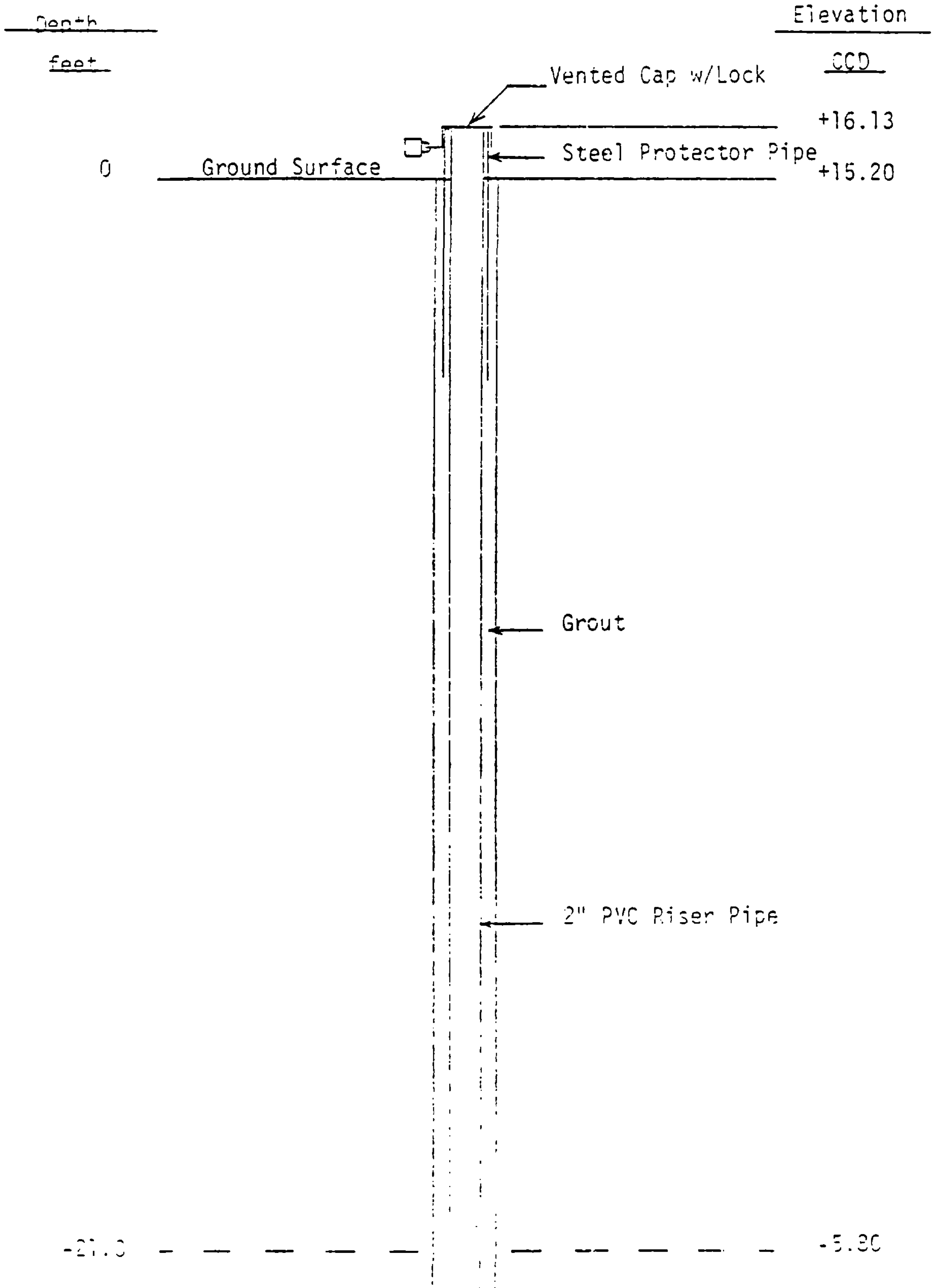


SOIL TESTING SERVICES, INC. | DATE 7/27/81 | PAGE ___ OF ___

CLIENT Illinois Attorney General | STS JOB NO 22063 | BY MGS | CHK ___

WELL DETAIL

G-105

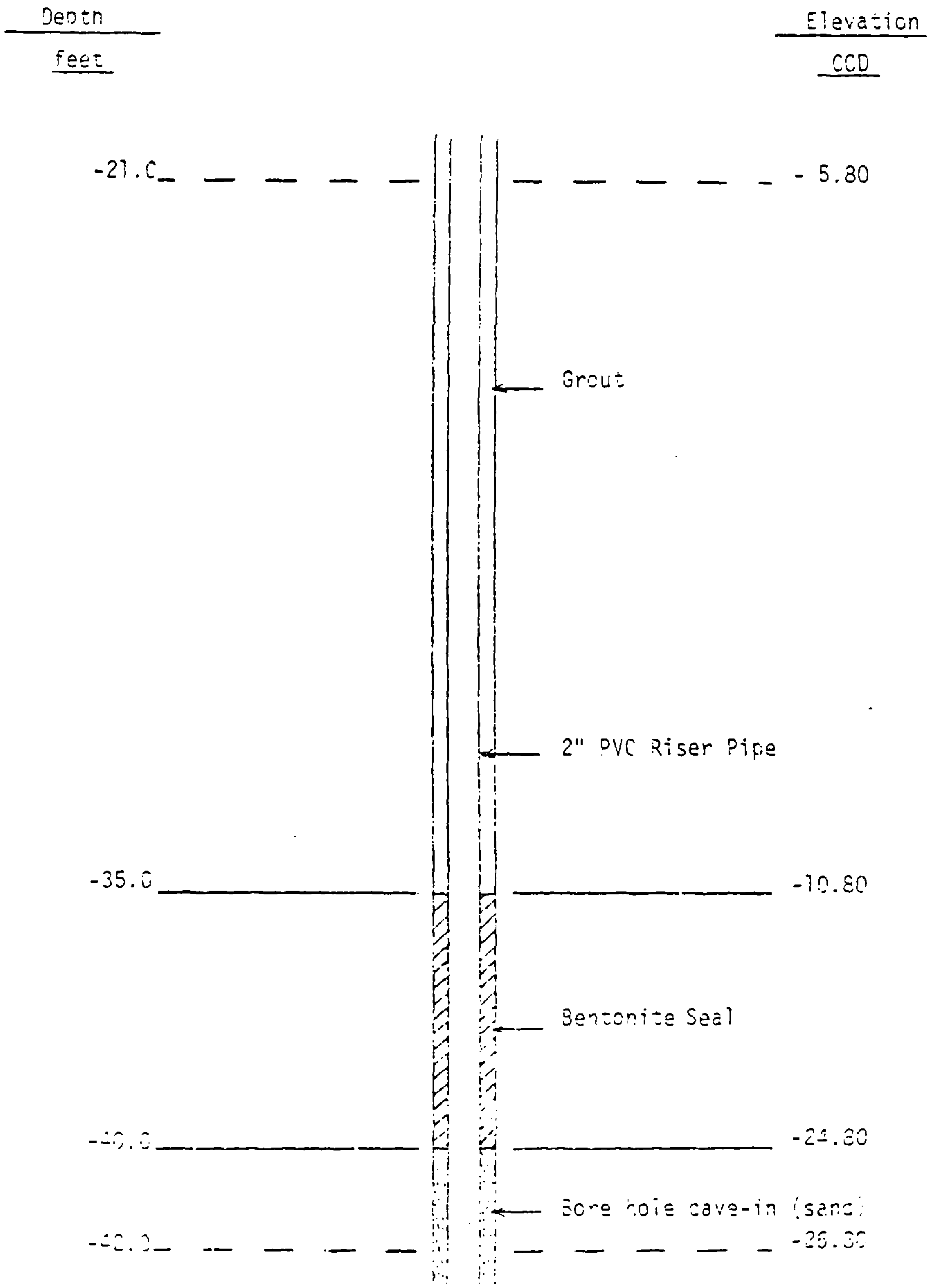


SOIL TESTING SERVICES, INC. | DATE 7/27/81 | PAGE ___ OF ___

CLIENT Illinois Attorney General STS JOB NO 22063 | BY MGS | CHK ______

WELL DETAIL (cont.)

G-105

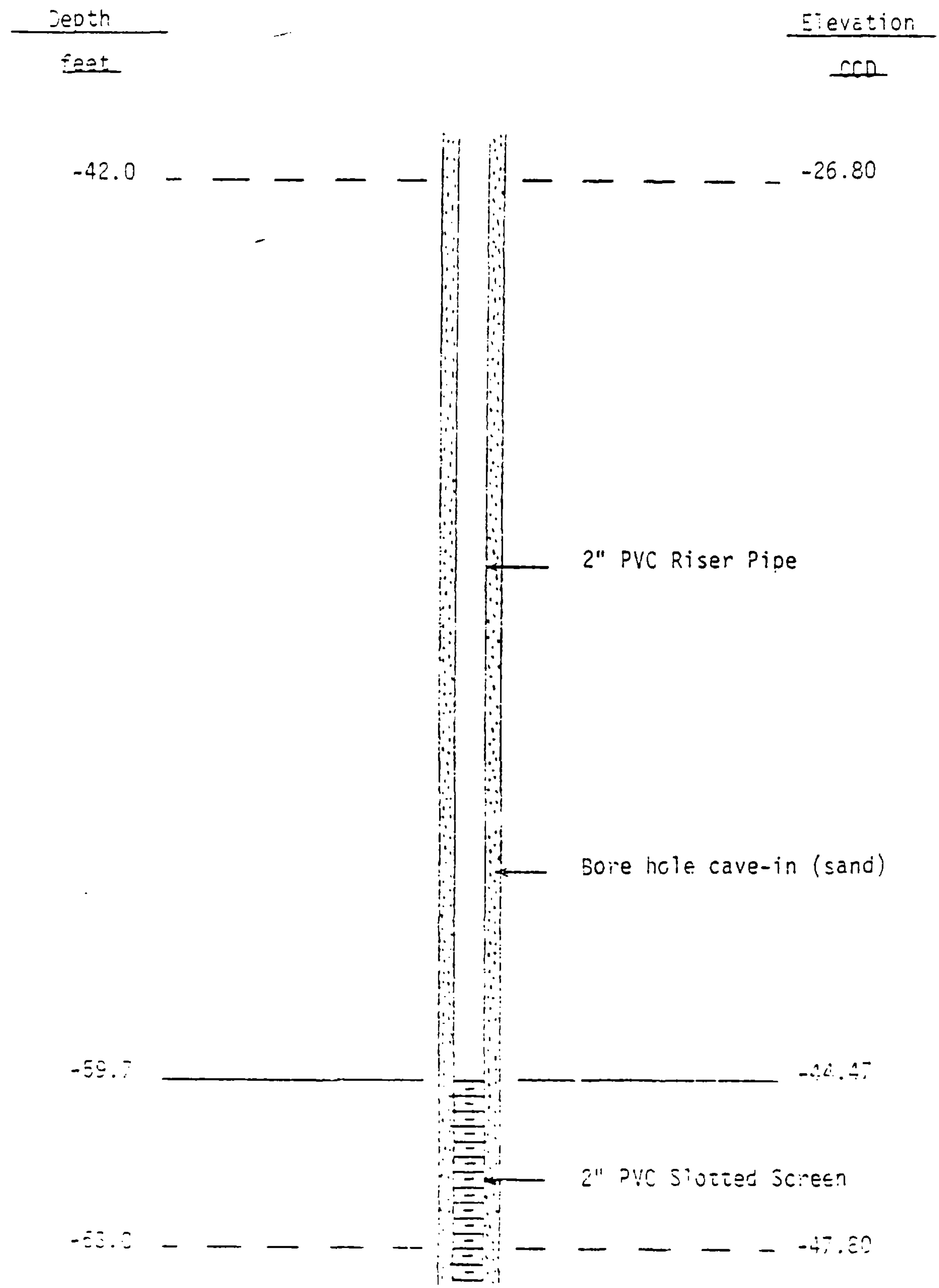


SOIL TESTING SERVICES, INC. | DATE 7/27/81 | PAGE ___ OF ___

CLIENT Illinois Attorney General | STS JOB NO 22063 | BY MGS | CHK ___

WELL DETAIL (cont.)

G-105



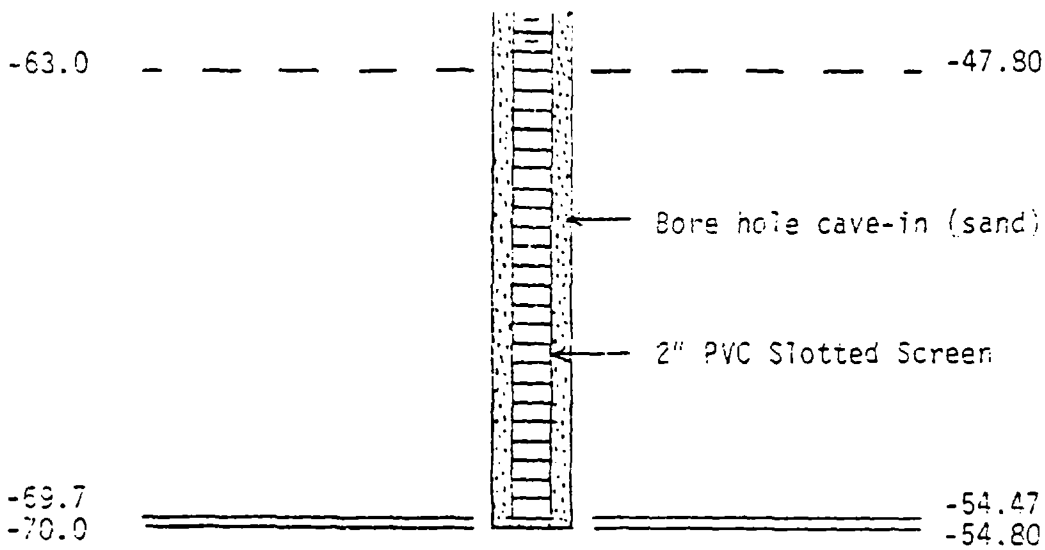
SOIL TESTING SERVICES, INC. | DATE 7/27/81 | PAGE ___ OF ___

CLIENT Illinois Attorney General STS JOB NO 22063 | BY MGS | CHK ___

WELL DETAIL (cont.)

G-105

Depth feet | Elevation CCD

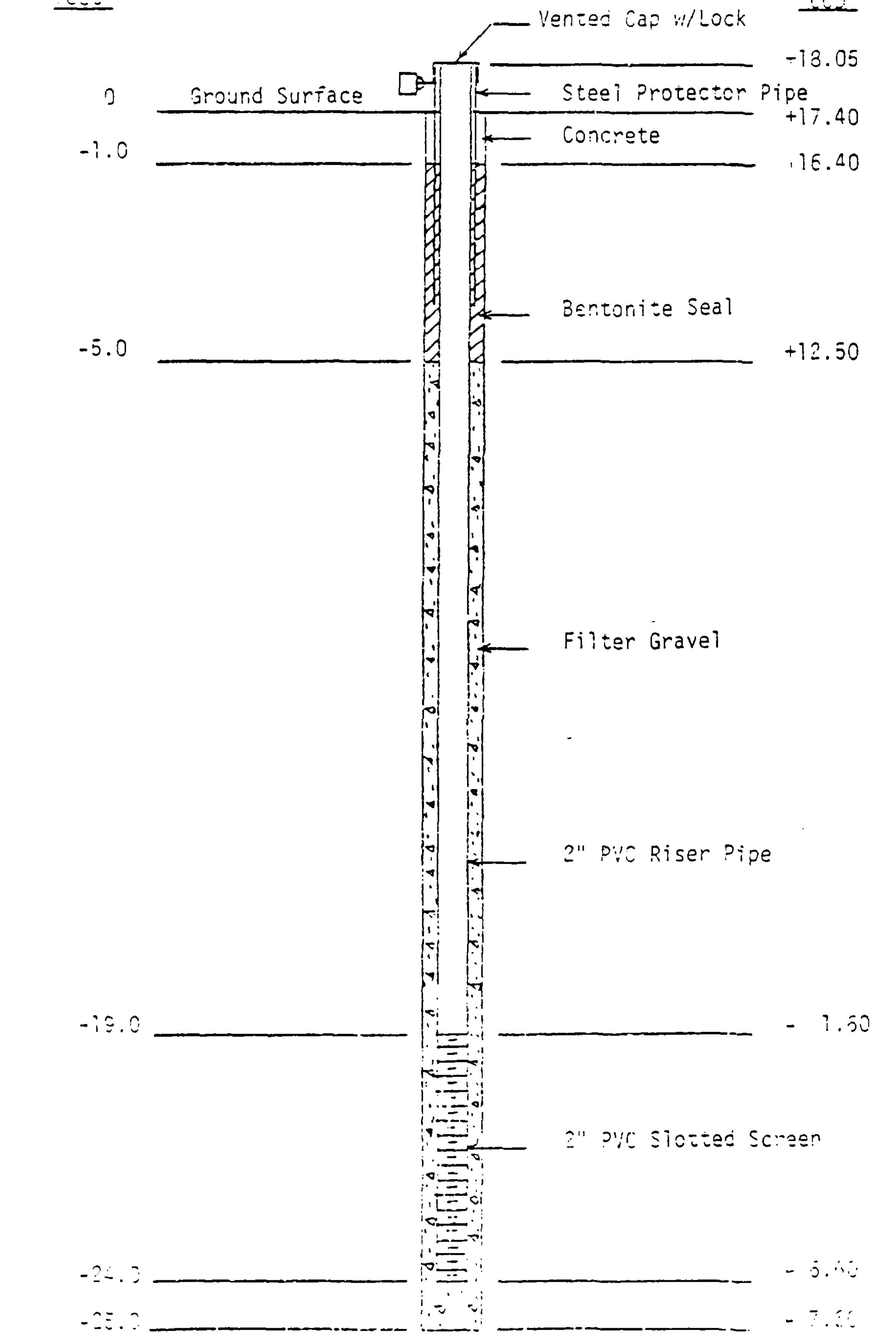


SOIL TESTING SERVICES, INC.

| | | | |
|---|---|---|---|
| | | DATE 7/27/81 | PAGE ___ OF ___ |
| CLIENT Illinois Attorney General | STS JOB NO 22063 | BY MGS | CHK ___ |

WELL DETAIL

G-133



## APPENDIX C

Test Pit Logs

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-1 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT. LBS./FT.³ | UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5 / PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50 / STANDARD PENETRATION BLOWS/FT 10 20 30 40 50 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Miscellaneous fill - wood, metal, sand, silt, large concrete blocks, metal containers - strong chemical smell (Fill) | | |
| | 5.0 | | | | | | | |
| | | | | | | END OF TEST PIT | | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

| | | | |
|---|---|---|---|
| WL | WS or WD | BORING STARTED [illegible] | SOIL TESTING SERVICES INC |
| WL | BCR ACR | BORING COMPLETED [illegible] | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 6006[illegible] |
| WL | | RIG [illegible] FOREMAN [illegible] | APP'D BY [illegible] STS JOB NO [illegible] |

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-2 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|---|---|
| | | | | | | Miscellaneous fill - wood, metal, sand, silt, large concrete blocks, metal containers -strong chemical odor - oily substance encountered at 6.0 ft | |
| | | | | | | END OF TEST PIT | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU. THE TRANSITION MAY BE GRADUAL

| | | | |
|---|---|---|---|
| WL | WS or WD | BORING STARTED 5/29/81 | SOIL TESTING SERVICES, INC. |
| WL | BCR ACR | BORING COMPLETED 5/29/81 | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |
| WL | | RIG Backhoe FOREMAN Cowley | APP'D BY MSS/TS · STS JOB NO 12960 |

| OWNER | LOG OF TEST PIT |
| --- | --- |
| Illinois Attorney General | TP-3 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |

SITE LOCATION

Lake Calumet Area, Chicago, Illinois

UNCONFINED COMPRESSIVE STRENGTH TONS/FT²: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS/FT³ |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | SURFACE ELEVATION | |
| | | | | | | "A" | |
| | | | | | | Oily material - saturated (Fill) | |
| | | | | | | Slag -white- hard (Fill) | |
| | | | | | | END OF TEST PIT | |
| | | | | | | "A" - Cinder and slag fill -black- loose - saturated (Fill) | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

| | | | | |
| --- | --- | --- | --- | --- |
| WL | [illegible] | WS or WD | BORING STARTED [illegible] | SOIL TESTING SERVICES, INC. |
| WL | BCR | ACR | BORING COMPLETED 5/29/81 | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |
| WL | | | RIG Backhoe FOREMAN Crowley | APP'D BY [illegible] STS JOB NO [illegible] |

| OWNER | LOG OF TEST PIT |
| --- | --- |
| Illinois Attorney General | TP-4 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT. LBS./FT.³ | UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² (1, 2, 3, 4, 5) — PLASTIC LIMIT %, WATER CONTENT %, LIQUID LIMIT % (10, 20, 30, 40, 50) — STANDARD PENETRATION BLOWS/FT (10, 20, 30, 40, 50) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | | | | Miscellaneous fill - sand, gravel, concrete & wood - saturated at 3.5 ft (Fill) | | |
| | | | | | | Silty clay -brown and black | | |
| | | | | | | END OF TEST PIT | | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

| | | |
| --- | --- | --- |
| WL | WS or WD | BORING STARTED 6/29/81 |
| WL | BCR | ACR | BORING COMPLETED 6/29/81 |
| WL | | RIG Backhoe FOREMAN [illegible] |

SOIL TESTING SERVICES, INC
111 PFINGSTEN ROAD
NORTHBROOK, ILLINOIS 60062

APP'D BY [illegible] | STS JOB NO [illegible]

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-5 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |

SITE LOCATION
Lake Calumet Area, Chicago, Illinois

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT. LBS./FT.³ | UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5 / PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50 / STANDARD PENETRATION BLOWS/FT 10 20 30 40 50 |
|---|---|---|---|---|---|---|---|---|
| | | | | | | "A" | | |
| 2.0 | | | | | | Wood - saturated with black water (Fill) | | |

END OF TEST PIT

"A" - Silty topsoil and brick fill (Fill)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

| WL | WS or WD | BORING STARTED 5/29/85 | SOIL TESTING SERVICES INC |
|---|---|---|---|
| WL BCR | ACR | BORING COMPLETED 5/29/85 | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |
| WL | | RIG Backhoe FOREMAN Crowley | APP'D BY MGS/ms · STS JOB NO 12060 |

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-6 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |

SITE LOCATION
Lake Calumet Area, Chicago, Illinois

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² — 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %: 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50

| ELEVATION | DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT LBS./FT³ |
|---|---|---|---|---|---|---|---|
| | | | | | | Concrete rubble, extremely dense (Fill) | |
| | | | | | | END OF TEST PIT | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU, THE TRANSITION MAY BE GRADUAL.

| | | | | |
|---|---|---|---|---|
| WL | WS or WD | BORING STARTED 5/29/91 | SOIL TESTING SERVICES, INC. 111 PFINGSTEN ROAD NORTHBROOK, ILLINOIS 60062 | |
| WL | BCR | ACR | BORING COMPLETED 5/29/91 | |
| WL | | RIG Backhoe | FOREMAN [illegible] | APP'D BY [illegible] | STS JOB NO. [illegible] |

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-7 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL<br>SURFACE ELEVATION | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|---|---|
| | 3.0 | | | | | Miscellaneous fill - wood and concrete Saturated with black water at 2.5 feet | |
| | | | | | | END OF TEST PIT | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL

| | | | |
|---|---|---|---|
| WL 2.5 | WS or WD | BORING STARTED 6/29/81 | SOIL TESTING SERVICES, INC.<br>111 PFINGSTEN ROAD<br>NORTHBROOK, ILLINOIS 60062 |
| WL BCR | ACR | BORING COMPLETED 6/29/81 | |
| WL | | RIG Backhoe FOREMAN Crowley | APP'D BY MGS ms / STS JOB NO. [illegible] |

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-8 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |

SITE LOCATION

Lake Calumet Area, Chicago, Illinois

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT LBS/FT³ |
|---|---|---|---|---|---|---|---|
| | | | | | | Miscellaneous fill - concrete, rebar, electrical conduits, silt clay (Fill) | |
| | 9.0 | | | | | | |
| | | | | | | END OF TEST PIT | |
| | | | | | | NOTE: Test pit performed in area of high anomaly in geophysical survey | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU THE TRANSITION MAY BE GRADUAL

| | | |
|---|---|---|
| WL Dry WS or WD | BORING STARTED 6/29/81 | SOIL TESTING SERVICES INC |
| WL BCR ACR | BORING COMPLETED 6/29/81 | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |
| WL | RG FOREMAN | APP'D BY STS JOB NO |

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-9 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT. LBS./FT.³ |
|---|---|---|---|---|---|---|---|
| | | | | | | Miscellaneous fill - wood, concrete, steel drums, metal, etc. (Fill) | |
| 5.0 | | | | | | | |
| 7.0 | | | | | | | |
| | | | | | | END OF TEST PIT | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN SITU THE TRANSITION MAY BE GRADUAL

| | | |
|---|---|---|
| WL WS or WD | BORING STARTED 6/29/81 | SOIL TESTING SERVICES, INC. |
| BCR ACR | BORING COMPLETED 6/29/81 | 111 PFINGSTEN ROAD NORTHBROOK, ILLINOIS 60062 |
| WL | RIG Backhoe FOREMAN Cowley | APP'D BY [illegible] STS JOB NO. [illegible] |

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-7 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

| ELEVATION | DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT. LBS./FT.³ |
|---|---|---|---|---|---|---|---|
| | | | | | | Miscellaneous fill - wood and concrete Saturated with black water at 2.5 feet | |
| | 3.0 | | | | | | |
| | | | | | | END OF TEST PIT | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN SITU THE TRANSITION MAY BE GRADUAL

| | | | |
|---|---|---|---|
| WL 2.5 | WS or WD | BORING STARTED 6/29/81 | SOIL TESTING SERVICES INC |
| WL BCR | ACR | BORING COMPLETED 6/29/81 | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |
| WL | | RIG Backhoe FOREMAN Crowley | APP'D BY MGS ms | STS JOB NO. [illegible] |

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-8 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

| ELEVATION / DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT LBS./FT.³ | UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5 / PLASTIC LIMIT % – WATER CONTENT % – LIQUID LIMIT % 10 20 30 40 50 / STANDARD PENETRATION BLOWS/FT 10 20 30 40 50 |
|---|---|---|---|---|---|---|---|
| | | | | | Miscellaneous fill - concrete, rebar, electrical conduits, silt clay (Fill) | | |
| 9.0 | | | | | | | |
| | | | | | END OF TEST PIT | | |
| | | | | | NOTE: Test pit performed in area of high anomaly in geophysical survey | | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU THE TRANSITION MAY BE GRADUAL

| | | | |
|---|---|---|---|
| WL | WS OR WD | BORING STARTED 5/29/81 | SOIL TESTING SERVICES, INC. 111 PFINGSTEN ROAD NORTHBROOK, ILLINOIS 60062 |
| WL | BCR ACR | BORING COMPLETED 5/29/81 | |
| WL | | RIG Backhoe FOREMAN | APP'D BY | STS JOB NO. |

| OWNER | LOG OF TEST PIT |
|---|---|
| Illinois Attorney General | TP-9 |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

| ELEVATION | DEPTH | SAMPLE NO | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT. LBS/FT³ |
|---|---|---|---|---|---|---|---|
| | | | | | | Miscellaneous fill - wood, concrete, steel drums, metal, etc. (Fill) | |
| | 5.0 | | | | | | |
| | 7.0 | | | | | | |
| | | | | | | END OF TEST PIT | |

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU THE TRANSITION MAY BE GRADUAL

| | | |
|---|---|---|
| W.L. WS or WD | BORING STARTED 6/29/81 | SOIL TESTING SERVICES, INC. 111 PFINGSTEN ROAD NORTHBROOK, ILLINOIS 60062 |
| W.L. BCR ACR | BORING COMPLETED 6/29/81 | |
| W.L. | RIG Backhoe FOREMAN Crowley | APP'D BY MGS/TS STS JOB NO. 21760 |

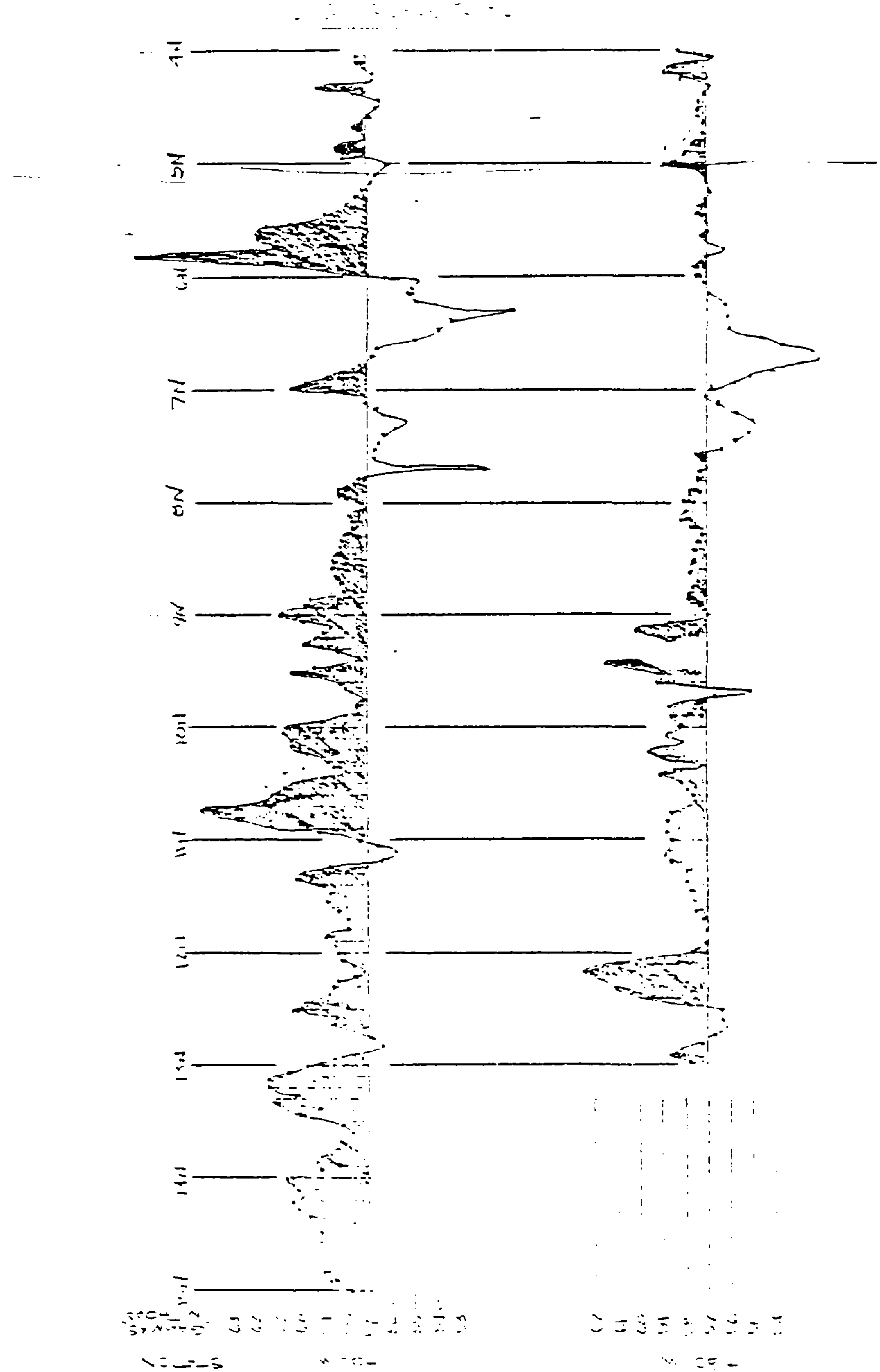
# APPENDIX D

Summary of Geophysical Data

## RESISTIVITY DATA

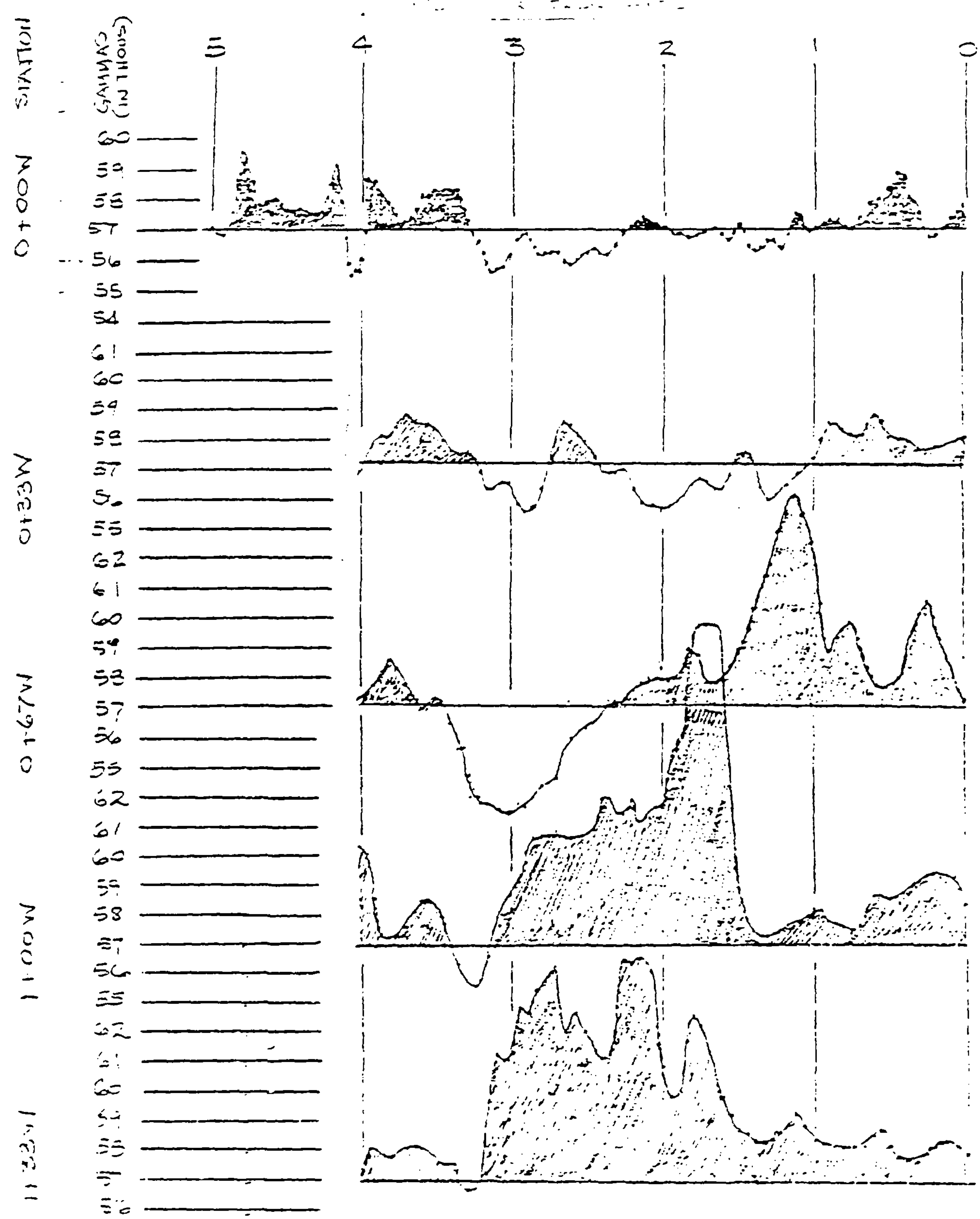
| Site | Station | Direction | Approximate Depth | Internal Resistivity (ohm-ft) |
|---|---|---|---|---|
| Penn Central | 1 | N - S | 2 | 414 |
| | | | 4 | 104 |
| | | | 6 | 67 |
| | | | 8 | 22 |
| | 2 | N - S | 5 | 189 |
| | | | 10 | 144 |
| | | | 15 | 130 |
| | | | 20 | 49 |
| | | | 25 | 15 |
| | | | 30 | 5 |
| | 2 | E - W | 5 | 226 |
| | | | 10 | 135 |
| | | | 15 | 30 |
| | | | 20 | 9 |
| | | | 25 | 21 |
| US Scrap | 1 | E - W | 5 | 186 |
| | | | 10 | 440 |
| | | | 15 | 140 |
| | 2 | E - W | 5 | 282 |
| | | | 15 | 311 |
| | | | 25 | 120 |
| | 3 | N - S | 5 | 30 |
| | | | 15 | 62 |

| SOIL TESTING SERVICES, INC. | DATE ______ | PAGE ___ OF ___ |
|---|---|---|
| PROJECT ______ STS JOB NO ______ | BY ______ | CHK ______ |



SOIL TESTING SERVICES, INC. | DATE ______ | PAGE ___ OF ___

PROJECT ______ STS JOB NO ______ | BY ______ | CHK ______



# APPENDIX E

Summary of Permeability Test Results

STS Job No. 22063
Project Illinois Attorney General

Date 6/24/81

# SUMMARY OF PERMEABILITY TEST RESULTS

| | | | | |
|---|---|---|---|---|
| Boring No. | G-105 | G-103 | G-103 | G-106 |
| Sample No. | 12 | 5 | 9 | 7 |
| Depth (ft) | 40-42 | 12.5-14.5 | 20-22 | 12.5-14.5 |
| Classification | CL | CL | CL | CL |
| Dry Unit Weight (pcf) | 123.1 | 105.2 | 109.7 | 117.8 |
| Water Content% | 12.8 | 20.3 | 19.3 | 19.0 |
| Diameter cm | 4.74 | 4.78 | 4.72 | 4.57 |
| Length cm | 5.06 | 6.87 | 6.98 | 6.91 |
| Saturation B Value | 1.0 | | | 1.0 |
| Permeability (cm/sec) | $2 \times 10^{-8}$ | $1 \times 10^{-8}$ | $3 \times 10^{-7}$ | $3 \times 10^{-8}$ |

# AMERICAN SOCIETY FOR TESTING AND MATERIALS

1916 Race St., Philadelphia, Pa. 19103

Reprinted from Copyrighted 1968 Book of ASTM Standards Part [illegible]

*Standard Method for*

# THIN-WALLED TUBE SAMPLING OF SOILS[1]

ASTM Designation: D 1587 – 67

This Standard of the American Society for Testing and Materials is issued under the fixed designation D 1587; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

## 1. Scope

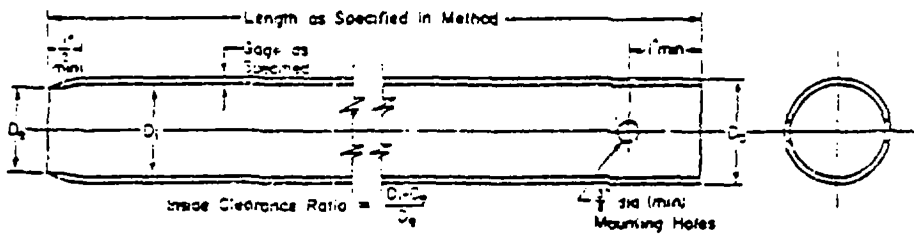
1.1 This method describes a procedure for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests. It is intended as a guide to more complete specifications to meet the needs of a particular job.

1.2 There are, in general, two types of samplers that use thin-walled tubes for sampling, namely, open-tube samplers, and piston samplers.[2] In general, piston samplers are better and can be used in almost all soils. Since the thin-walled tube requirements are the same for both types of samplers, the method described applies equally to both.

## 2. Apparatus

2.1 *Drilling Equipment*—Any drilling equipment may be used that provides a reasonably clean hole before insertion of the thin-walled tube; that does not disturb the soil to be sampled, and that can effect continuous and rapid penetration of the tube into the sampled soil.

2.2 *Thin-Walled Tubes*—Thin-walled tubes 2 to 5 in. (50.8 to 127 mm) in outside diameter and made of any materials having adequate strength and resistance to corrosion will be satisfactory (Fig. 1). Adequate resistance to corrosion can be provided by a suitable coating. Sizes other than these may be used, if specified.




NOTE 1—Minimum of two mounting holes on opposite sides for 2 to 3½ in. sampler.
NOTE 2—Minimum of four mounting holes spaced at 90 deg for samplers 4 in. and larger.
NOTE 3—Tube held with hardened screws.

TABLE OF METRIC EQUIVALENTS.

| in. | mm | cm |
|---|---|---|
| ¼ | 6.77 | ... |
| ½ | 12.7 | 1.27 |
| 1 | 25.4 | 2.54 |
| 2 | ... | 5.08 |
| 3½ | ... | 8.89 |
| 4 | ... | 10.16 |

FIG. 1—Thin-Walled Tube for Sampling.

2.2.1 Tubes shall be of such a length that between five and ten times the diameter is available for penetration into sands and between ten and fifteen diameters is available for penetration into clays. Tubes shall be round and smooth, without bumps, dents, or scratches. They shall be clean, and free from rust and dirt. Seamless or welded tubes are permissible, but welds must not project at the seam. The cutting edge shall be machined as shown in Fig. 1 and shall be free from

TABLE 1—SUITABLE THIN-WALLED STEEL SAMPLE TUBES.[a]

| | | | |
|---|---|---|---|
| Outside diameter: | | | |
| in. | 2 | 3 | 5 |
| mm | 50.8 | 76.2 | 127 |
| Wall thickness: | | | |
| Bwg | 18 | 16 | 11 |
| in. | 0.049 | 0.065 | 0.120 |
| mm | 1.24 | 1.65 | 3.05 |
| Tube length: | | | |
| in. | 36 | 36 | 54 |
| m | [illegible] | 0.91 | 1.45 |
| Clearance ratio, per cent | [illegible] | 1 | [illegible] |

[a] The three diameters recommended in Table 1 are indicated for purposes of standardization, and are not intended to indicate that sampling tubes of intermediate or larger diameters are not acceptable. Lengths of tubes shown are illustrative. Proper lengths to be determined as suited to field conditions.

[1] Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee D-18 on Soil and Rock for Engineering Purposes. A list of members may be found in the ASTM Year Book.

Current edition issued Oct. 20, 1967. Originally issued 1958. Replaces D 1587 – 63 T.

[2] Hvorslev, M. J., *Surface Exploration and Sampling of Soils for Civil Engineering Purposes*, The Engineering Foundation, 345 East 47th St., New York, N. Y. 10017.

AMERICAN SOCIETY FOR TESTING AND MATERIALS

1916 Race St., Philadelphia, Pa. 19103

Reprinted from Copyrighted 1968 Book of ASTM Standards, Part 11

# *Standard Method for*

# PENETRATION TEST AND SPLIT-BARREL SAMPLING OF SOILS[1]

ASTM Designation: D 1586 – 67

This Standard of the American Society for Testing and Materials is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval.

## 1. Scope

1.1 This method describes a procedure for using a split-barrel sampler to obtain representative samples of soil for identification purposes and other laboratory tests, and to obtain a measure of the resistance of the soil to penetration of the sampler.

## 2. Apparatus

2.1 *Drilling Equipment*—Any drilling equipment shall be acceptable that provides a reasonably clean hole before insertion of the sampler to ensure that the penetration test is performed on undisturbed soil, and that will permit the driving of the sampler to obtain the sample and penetration record in accordance with the procedure described in 3. Procedure. To avoid "whips" under the blows of the hammer, it is recommended that the drill rod have a stiffness equal to or greater than the A-rod. An "A" rod is a hollow drill rod or "steel" having an outside diameter of $1\frac{5}{8}$ in. or 41.2 mm and an inside diameter of $1\frac{1}{8}$ in. or 28.5 mm, through which the rotary motion of drilling is transferred from the drilling motor to the cutting bit. A stiffer drill rod is suggested for holes deeper than 50 ft (15 m). The hole shall be limited in diameter to between $2\frac{1}{4}$ and 6 in. (57.2 and 152 mm).[2]

2.2 *Split-Barrel Sampler*—The sampler shall be constructed with the dimensions indicated in Fig. 1. The drive shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The coupling head shall have four $\frac{1}{2}$-in. (12.7-mm) (minimum diameter) vent ports and shall contain a ball check valve. If sizes other than the 2-in. (50.8-mm) sampler are permitted, the size shall be conspicuously noted on all penetration records.

2.3 *Drive Weight Assembly*—The assembly shall consist of a 140-lb (63.5-kg) weight, a driving head, and a guide permitting a free fall of 30 in. (0.76 m). Special precautions shall be taken to ensure that the energy of the falling weight is not reduced by friction between the drive weight and the guides.

2.4 *Accessory Equipment*—Labels, data sheets, sample jars, paraffin, and other necessary supplies should accompany the sampling equipment.

## 3. Procedure

3.1 Clear out the hole to sampling elevation using equipment that will ensure that the material to be sampled is not disturbed by the operation. In saturated sands and silts withdraw the drill bit slowly to prevent loosening of the soil around the hole. Maintain the water level in the hole at or above ground water level.

3.2 In no case shall a bottom-discharge bit be permitted. (Side-discharge bits are permissible.) The process of jetting through an open-tube sampler and then sampling when the desired depth is reached shall not be permitted. Where casing is used, it may not be driven below sampling elevation. Record any loss of circulation or excess pressure in drilling fluid during advancing of holes.

3.3 With the sampler resting on the bottom of the hole, drive the sampler with blows from the 140-lb (63.5-kg) hammer falling 30 in. (0.76 m) until either 18 in. (0.45 m) have been penetrated or 100 blows have been applied.

3.4 Repeat this operation at intervals not longer than 5 ft (1.5 m) in homogeneous strata and at every change of strata.

3.5 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fractions thereof. The first 6 in. (0.15 m) is considered to be a seating drive. The number of blows required for the second and third 6 in. (0.15 m) of penetration added is termed the penetration resistance, *N*. If the sampler is driven less than 18 in. (0.45 m), the penetration resistance is that for the last 1 ft (0.30 m) of penetration. If less than 1 ft (0.30 m) is penetrated, the logs shall state the number of blows and the fraction of 1 ft (0.30 m) penetrated.

3.6 Bring the sampler to the surface and open. Describe carefully typical

---

[1] Under the standardization procedure of the Society, this method is under the jurisdiction of the ASTM Committee D-18 on Soil and Rock for Engineering Purposes. A list of members may be found in the ASTM Year Book.

Current edition accepted Oct. 20, 1967. Originally issued 1958. Replaces D 1586 – 64 T.

[2] Hvorslev, M. J., *Subsurface Exploration and Sampling of Soils for Civil Engineering Purposes*, The Engineering Foundation, 345 East 47th St., New York, N. Y. 10017.

## PROCEDURES REGARDING FIELD LOGS.

## LABORATORY DATA SHEETS AND SAMPLES

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering.

Specifically, field logs are prepared during performance of the drilling and sampling operations which are intended to portray essentially field occurrences, sampling locations and other information.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by more experienced soil engineers, and differences between the field logs and the final logs exist.

The engineer preparing the report reviews the field and laboratory logs, classifications and test data, and in his judgement in interpreting this data, may make further changes.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then destroyed unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, an inspection of these samples should recognize this factor.

It is common practice in the soil and foundation engineering profession that field logs and laboratory data sheets not be included in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. On the other hand, we are aware that perhaps certain contractors and subcontractors submitting bids or proposals on work might have an interest in studying these documents before submitting a bid or proposal. For this reason, the field logs will be retained in our office for inspection by all contractors submitting a bid or proposal. We would welcome the opportunity to explain any changes that have and typically are made in the preparation of our final reports, to the contractor or subcontractors, before the firm submits its bid or proposal, and to describe how the information was obtained to the extent the contractor or subcontractor wishes. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

The descriptive terms and symbols used on the logs are described on the attached sheet, entitled, General Notes.

# GENERAL NOTES

## DRILLING & SAMPLING SYMBOLS:

| | | | | | |
|---|---|---|---|---|---|
| SS | : | Split Spoon - 1 3/8" I.D., 2" O.D. Unless otherwise noted | OS | : | Osterberg Sampler - 3" Shelby Tube |
| | | | HS | : | Hollow Stem Auger |
| ST | : | Shelby Tube - 2" O.D., Unless otherwise noted | WS | : | Wash Sample |
| | | | FT | : | Fish Tail |
| PA | : | Power Auger | RB | : | Rock Bit |
| DB | : | Diamond Bit - NX, BX, AX | BS | : | Bulk Sample |
| AS | : | Auger Sample | PM | : | Pressuremeter Test, In-Situ |
| JS | : | Jar Sample | GS | : | Giddings Sampler |
| VS | : | Vane Shear | | | |

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

## WATER LEVEL MEASUREMENT SYMBOLS:

| | | | | | |
|---|---|---|---|---|---|
| WL | : | Water Level | WCI | : | Wet Cave in |
| WS | : | While Sampling | DCI | : | Dry Cave in |
| WD | : | While Drilling | BCR | : | Before Casing Removal |
| AB | : | After Boring | ACR | : | After Casing Removal |

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of ground water elevations may not be possible, even after several days of observations; additional evidence of ground water elevations must be sought.

## GRADATION DESCRIPTION & TERMINOLOGY:

Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays or clayey silts if they are cohesive and silts if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

| Major Component Of Sample | Size Range | Descriptive Term Of Components Also Present in Sample | Percent Of Dry Weight |
|---|---|---|---|
| Boulders | Over 8 in. (200 mm) | Trace | 1 - 9 |
| Cobbles | 8 inches to 3 inches (200 mm to 75 mm) | Little | 10 - 19 |
| Gravel | 3 inches to #4 sieve (75 mm to 4.76 mm) | Some | 20 - 34 |
| Sand | #4 to #200 sieve (4.76 mm to 0.074 mm) | And | 35 - 50 |
| Silt | Passing #200 sieve (0.074 mm to 0.005 mm) | | |
| Clay | Smaller than 0.005 mm | | |

## CONSISTENCY OF COHESIVE SOILS:

| Unconfined Compressive Strength, Qu, tsf | Consistency |
|---|---|
| < 0.25 | Very Soft |
| 0.25 - 0.49 | Soft |
| 0.50 - 0.99 | Medium (Firm) |
| 1.00 - 1.99 | Stiff |
| 2.00 - 3.99 | Very Stiff |
| 4.00 - 8.00 | Hard |
| > 8.00 | Very Hard |

## RELATIVE DENSITY OF GRANULAR SOILS:

| N - Blows per ft. | Relative Density |
|---|---|
| 0 - 3 | Very Loose |
| 4 - 9 | Loose |
| 10 - 29 | Medium Dense |
| 30 - 49 | Dense |
| 50 - 80 | Very Dense |
| 80+ | Extremely Dense |

## Standard Clause for Unanticipated Subsurface Conditions

"The owner has had a subsurface investigation performed by a foundation consultant, the results of which are contained in the consultant's report. The consultant's report presents his conclusions on the subsurface conditions based on his interpretation of the data obtained in the investigation. The contractor acknowledges that he has reviewed the consultant's report and any addenda thereto, and that his bid for earthwork operations is based on the subsurface conditions, as described in that report. It is recognized that a subsurface investigation may not disclose all conditions as they actually exist and further, conditions may change. particularly groundwater conditions, between the time of a subsurface investigation and the time of earthwork operations. In recognition of these facts, this clause is entered in the contract to provide a means of equitable additional compensation for the contractor if adverse unanticipated conditions are encountered and to provide a means of rebate to the owner if the conditions are more favorable than anticipated.

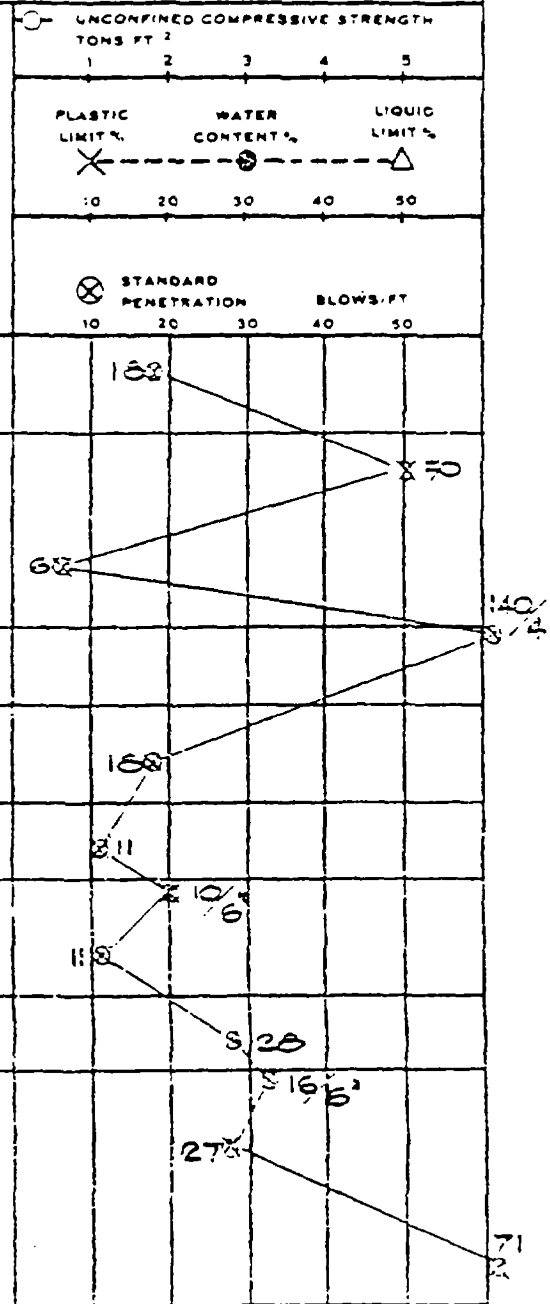
At any time during earthwork, paving and foundation construction operations that the contractor encounters conditions that are different than those anticipated by the foundation consultant's report, he shall immediately (within 24 hours) bring this fact to the owner's attention. If the owner's representative on the construction site observes subsurface conditions which are different than those anticipated by the foundation consultant's report, he shall immediately (within 24 hours) bring this fact to the contractor's attention. Once a fact of unanticipated conditions has been brought to the attention of either the owner or the contractor, and the consultant has concurred, immediate negotiations will be undertaken between the owner and the contractor to arrive at a change in contract price for additional work or reduction in work because of the unanticipated conditions. The contractor agrees that the following unit prices would apply for additional or reduced work under the contract. For changed conditions for which unit prices are not provided, the additional work shall be paid for on a time and material basis."

Another example of a changed conditions clause can be found in paper No. 4035 by Robert F. Borg published in ASCE Construction Division Journal, No. CO2, September 1964, page 37.

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-133 |
| **PROJECT NAME** | **ARCHITECT-ENGINEER** |
| Contamination Survey | |
| **SITE LOCATION** | |
| Lake Calumet Area, Chicago, Illinois | |

SURFACE ELEVATION +17.4 CCD

| SAMPLE NO. | SAMPLE TYPE | DESCRIPTION OF MATERIAL |
|---|---|---|
| 1 | SS | Clayey topsoil, little wood, trace roots -dk. brown (OH-Fill) |
| | RB | |
| 2 | SS | Saturated wood fragments -black- (Fill) Sample 3: not recovered |
| | RB | |
| 3 | SS | |
| | RB | Gravel fill -light gray- extr. dense - saturated (GP-Fill) Very high pH level |
| 4 | RB | |
| | RB | |
| 5 | SS | Sandy clay fill (slightly tar-like), trace wood, gravel & roots -black- very stiff (Fill) Paint odor |
| | RB | |
| 6 | SS | Silty clay, trace gravel, sand and shale -brown, gray & black- stiff to very stiff (CL) Paint odor |
| | RB | |
| 7 | SS | Silty clay, trace gravel, sand and shale -grayish brown- stiff (CL) Slight paint odor |
| | RB | |
| 8 | SS | Silty clay, trace gravel, sand and shale -grayish brown- very stiff to hard (CL) |
| | RB | |
| 9 | SS | |
| | RB | Silty clay, trace gravel, sand and shale -brownish gray- very stiff to hard (CL) |
| 10 | SS | |




END OF BORING

NOTE: Consistencies of clay based on Standard Penetration Tests
See "Well Detail - G-133" for monitoring well characteristics.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU THE TRANSITION MAY BE GRADUAL.

| WL [illegible] | WS or WD | BORING STARTED [illegible] | SOIL TESTING SERVICES INC |
|---|---|---|---|
| WL | BCR | ACR / BORING COMPLETED [illegible] | 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |
| WL | | RIG [illegible] FOREMAN [illegible] | APP'D BY [illegible] / STS JOB NO [illegible] |

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-132 |
| **PROJECT NAME** | **ARCHITECT-ENGINEER** |
| Contamination Survey | |
| **SITE LOCATION** | |
| Lake Calumet Area, Chicago, Illinois | |

SURFACE ELEVATION +19.8 CCD

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50

| SAMPLE NO. | SAMPLE TYPE | DESCRIPTION OF MATERIAL | UNIT DRY WT. LBS./FT.³ | Plotted values |
|---|---|---|---|---|
| 1 | SS | Sandy & gravelly fill (crushed stone) -lt. gray- medium dense to very dense (Fill) Very high pH level | | 7? |
| 2 | SS | | | 26 |
| 3 | SS | Wood - no sample recovered | | 47 |
| 4 | SS | | | 49 |
| 4A | | Clayey fill, trace gravel, sand and wood -black & gray- very stiff - Very strong paint odor | | 21 |
| 5 | SS | | | 22 |
| 5A | | | | 19 |
| 6 | SS | Oily cinder fill -black- medium dense - saturated with oil | | 27 |
| | RS | | | 14 |
| 7 | SS | Silty organic clay -black- stiff to very stiff (OH) | | |
| 7A | | | | 19 |
| | RS | | | |
| 8 | SS | Silty clay, trace gravel, sand and shale -brown & gray- very stiff (CL) | | 24 |
| | RS | | | |
| 9 | SS | | | 16 |
| | RS | | | |
| 10 | SS | Silty clay, trace gravel, sand and shale -gray- hard (CL) | | 27 |
| | RS | | | |
| 11 | SS | | | 39 |

END OF BORING

NOTE: Obstruction encountered at 4.5 ft. Boring reset 5 ft south. Consistencies of clay based on Standard Penetration Test. See "Well Detail -G-132" for monitoring well characteristics.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES; IN SITU, THE TRANSITION MAY BE GRADUAL.

| | | | |
|---|---|---|---|
| W.L. | WS or WD | BORING STARTED 9/26/81 | SOIL TESTING SERVICES, INC. 111 PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 |
| W.L. BCR | ACR | BORING COMPLETED 9/26/81 | |
| W.L. | | RIG [illegible] FOREMAN [illegible] | APP'D BY [illegible] STS JOB NO [illegible] |

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-106 |
| **PROJECT NAME** | **ARCHITECT-ENGINEER** |
| Contamination Survey | |

**SITE LOCATION**

Lake Calumet Area, Chicago, Illinois

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT 10 20 30 40 50

SURFACE ELEVATION +9.9 CCD

| ELEVATION / DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL | UNIT DRY WT LBS./FT.³ |
|---|---|---|---|---|---|---|
| | 1 | SS | | | Granular fill -black (Fill) | |
| | 1A | | | | Med. to coarse sand -rust (SP) | |
| | 2 | SS | | | "A" | |
| | 2A | | | | Med. to coarse sand -rust (SP) | |
| 5.0 | 3 | ST | | | | 110 |
| | 4 | ST | | | Silty clay, trace gravel, sand, shale & gypsum crystals -brown & gray- stiff to very stiff (CL) | |
| | 4A | PA | | | | |
| | 5 | SS | | | | |
| | 5A | | | | Silty clay, trace gravel, sand and shale -gray- very stiff (CL) | |
| 10.0 | | PA | | | | |
| | 6 | ST | | | $K = 3 \times 10^{-8}$ cm/sec | 113 |
| | 6A | | | | | |
| 14.5 | 7 | ST | | | | 107 |

END OF BORING

*CALIBRATED PENETROMETER

"A" - Silty clay, little topsoil -brown, gray and black (CL)

NOTE: See "Well Detail -G-106" for monitoring well characteristics

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN SITU THE TRANSITION MAY BE GRADUAL.

| | | | |
|---|---|---|---|
| WL [illegible] WS ~~OR~~ WD | BORING STARTED [illegible] | SOIL TESTING SERVICES, INC | |
| WL BCR ACR | BORING COMPLETED [illegible] | [illegible] PFINGSTEN ROAD NORTHBROOK ILLINOIS 60062 | |
| WL | RIG [illegible] FOREMAN [illegible] | APP'D BY [illegible] | STS JOB NO. [illegible] |

| OWNER | LOG OF BORING NUMBER |
|---|---|
| Illinois Attorney General | G-105 (cont.) |
| PROJECT NAME | ARCHITECT-ENGINEER |
| Contamination Survey | |
| SITE LOCATION | |
| Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %
10 20 30 40 50

STANDARD PENETRATION BLOWS/FT
10 20 30 40 50

| ELEVATION | DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT LBS./FT.³ |
|---|---|---|---|---|---|---|---|
| | | | | | | Continued from Previous Page | |
| | | | | | | NOTE: See "Well Detail - G-105" for monitoring well characteristics Obstruction encountered at 1.5 ft. Boring offset 4 ft north | |
| | | | | | | Casing used: 10' of 4" | |



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES IN SITU. THE TRANSITION MAY BE GRADUAL.

| | | | |
|---|---|---|---|
| WL 6' | WS or WD | BORING STARTED 6/20/8? | SOIL TESTING SERVICES, INC. |
| WL 3CR | ACR | BORING COMPLETED 6/20/8? | [illegible] ZFINGSTEN ROAD NORTHBROOK ILLINOIS [illegible] |
| WL | | RIG [illegible] FOREMAN [illegible] | APP'D BY [illegible] STS JOB NO [illegible] |

| | |
|---|---|
| OWNER: Illinois Attorney General | LOG OF BORING NUMBER: G-105 (cont.) |
| PROJECT NAME: Contamination Survey | ARCHITECT-ENGINEER: |
| SITE LOCATION: Lake Calumet Area, Chicago, Illinois | |

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.$^2$ 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50

| ELEVATION / DEPTH | SAMPLE NO. | SAMPLE TYPE | SAMPLE DISTANCE | RECOVERY | DESCRIPTION OF MATERIAL / SURFACE ELEVATION | UNIT DRY WT. LBS./FT.³ |
|---|---|---|---|---|---|---|
| | | | | | Continued from Previous Page | |
| 37.0 | | FT | | | Silty clay, little sand, trace gravel & shale -gray- hard (CL) | |
| 40.0 | 12 | ST | | | K = 2 X $10^{-8}$ cm/sec | |
| | | FT | | | | |
| 45.0 | 13 | ST | | | | 125 |
| | | FT | | | | |
| 50.0 | 14 | SS | | | | |
| 55.0 | | FT | | | | |
| | 15 | SS | | | | |
| | | FT | | | | |
| 60.0 | 16 | SS | | | Clayey silt, trace gravel, sand and shale -gray- extr. dense - moist (ML) | |
| | | FT | | | | |
| 65.0 | | SS | | | Broken bedrock and/or boulders. NOTE: Revert used at 66 ft to stop cave-in. | |
| | | RB | | | Limestone bedrock | |
| | | | | | END OF BORING | |

*CALIBRATED PENETROMETER

Continued on Next Page

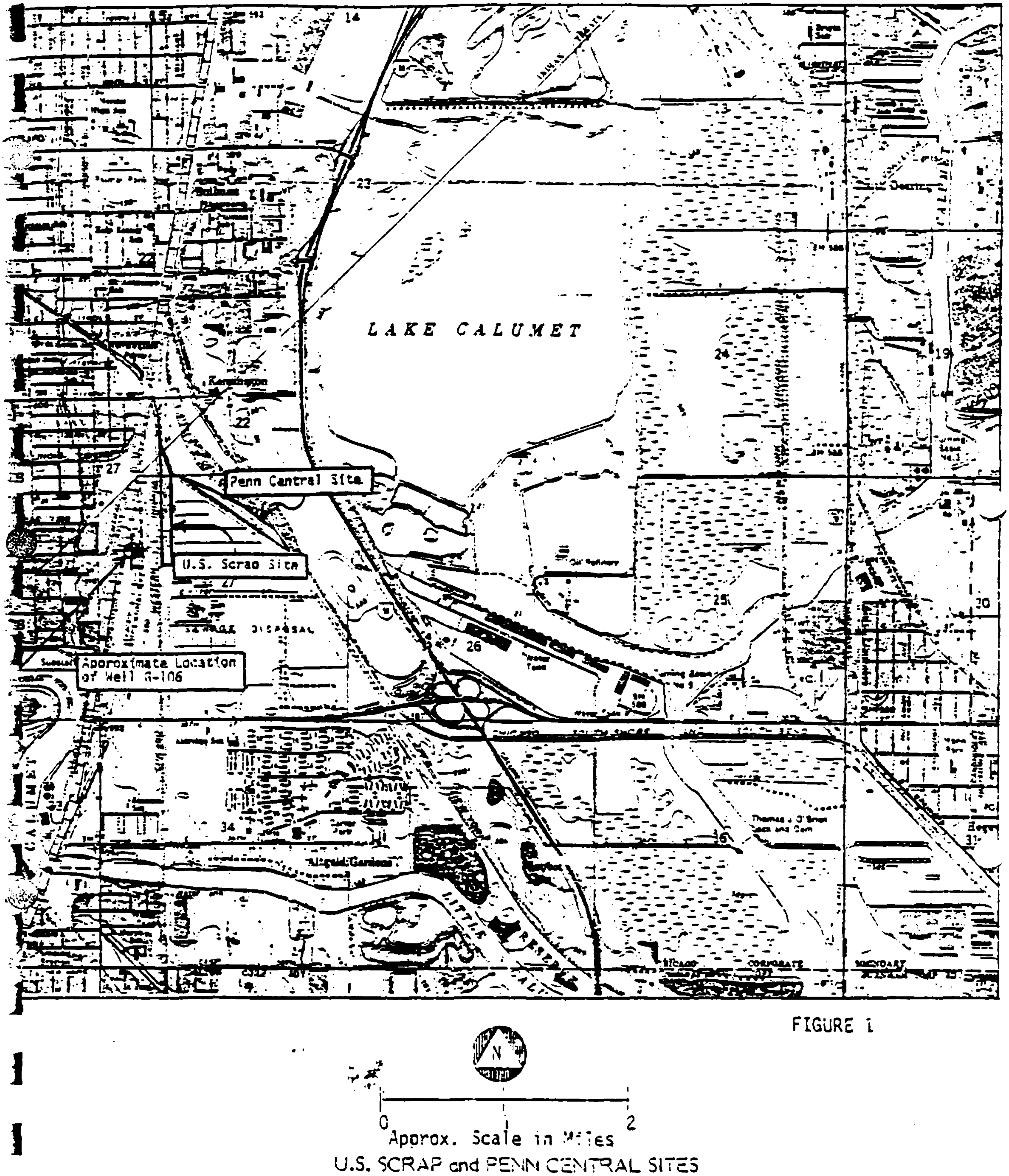
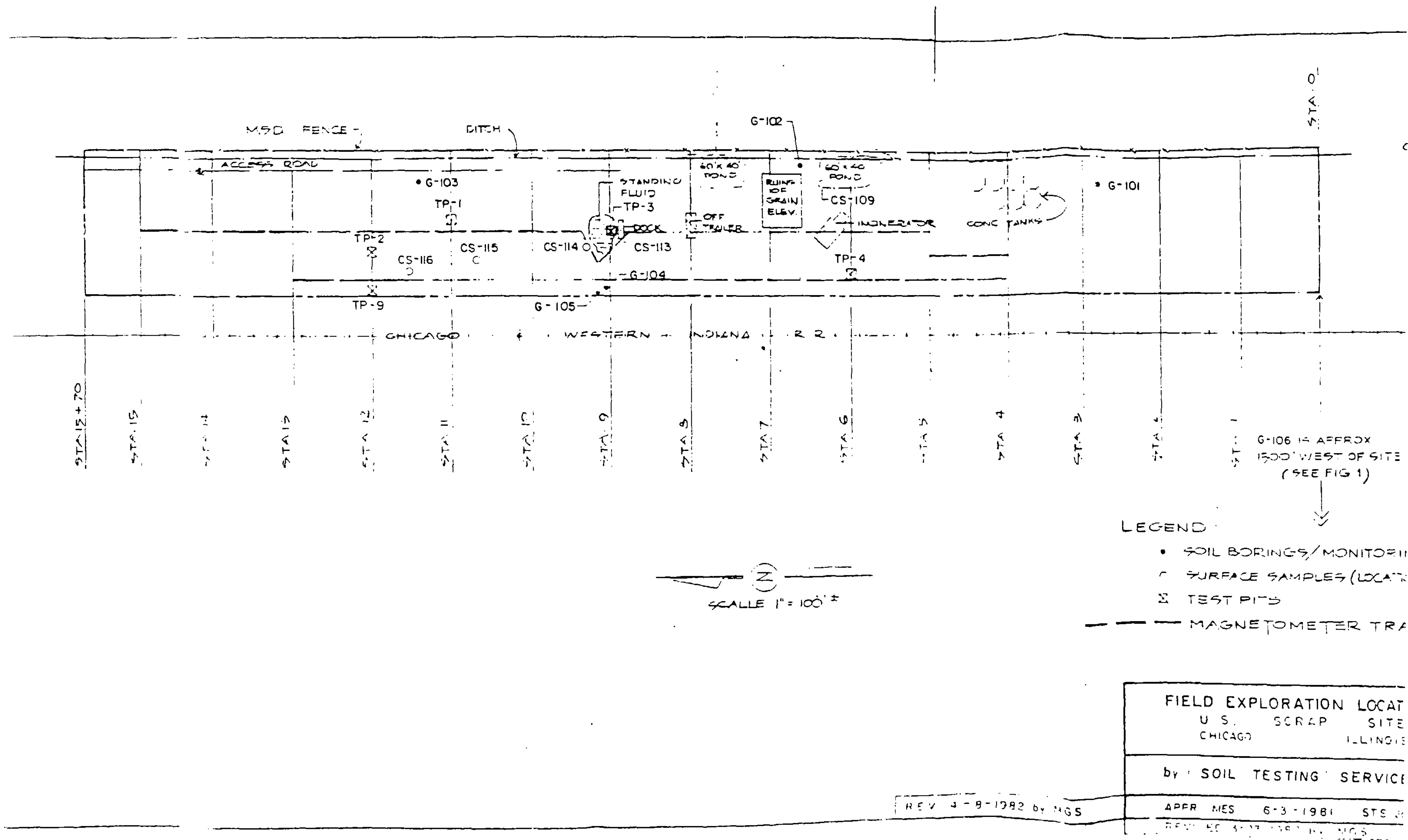



FIGURE 1

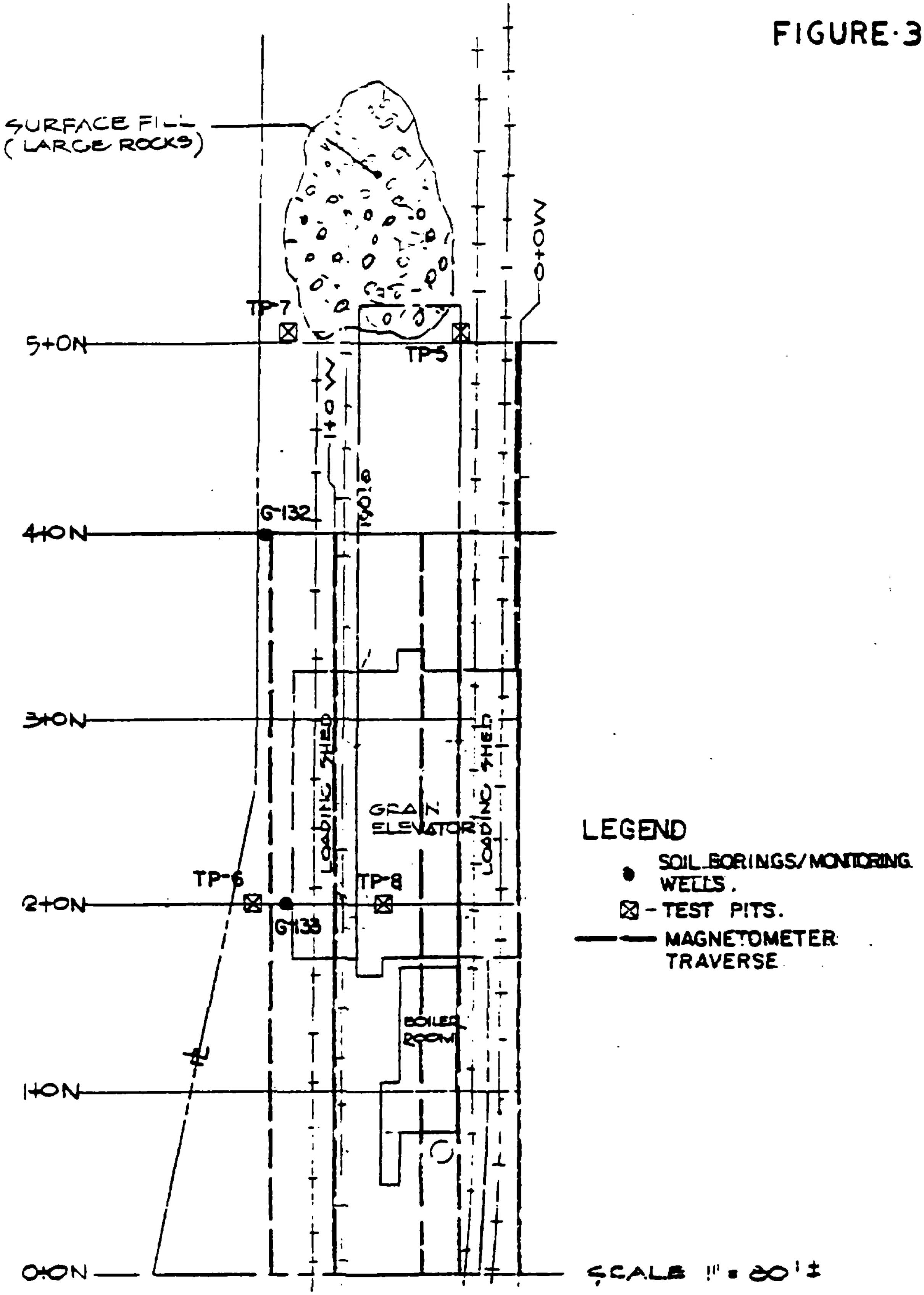
U.S. SCRAP and PENN CENTRAL SITES

United States Geological Survey
Topographic Map of Lake Calumet (Illinois) Quadrangle
7.5 Minute Series - 1963



MSD FENCE
DITCH
ACCESS ROAD
G-102
G-103
G-101
TP-1
TP-2
TP-3
TP-4
TP-9
STANDING FLUID
ROCK
CS-116
CS-115
CS-114
CS-113
CS-109
G-104
G-105
60'x 40' POND
60 x 40 POND
RUINS OF GRAIN ELEV.
OFF TRAILER
INCINERATOR
CONC TANKS
CHICAGO WESTERN INDIANA R R
STA 0
STA 15+70
STA 15
STA 13
STA 12
STA 11
STA 10
STA 9
STA 8
STA 7
STA 6
STA 5
STA 4
STA 3
G-106 IS APPROX 1500' WEST OF SITE (SEE FIG 1)
LEGEND
SOIL BORINGS/MONITORI
SURFACE SAMPLES (LOCAT
TEST PITS
MAGNETOMETER TRA
SCALE 1" = 100' ±
FIELD EXPLORATION LOCAT
U.S. SCRAP SITE
CHICAGO ILLINOIS
by SOIL TESTING SERVICE
APPR NES 6-3-1981 STS
REV 4-8-1982 by NGS

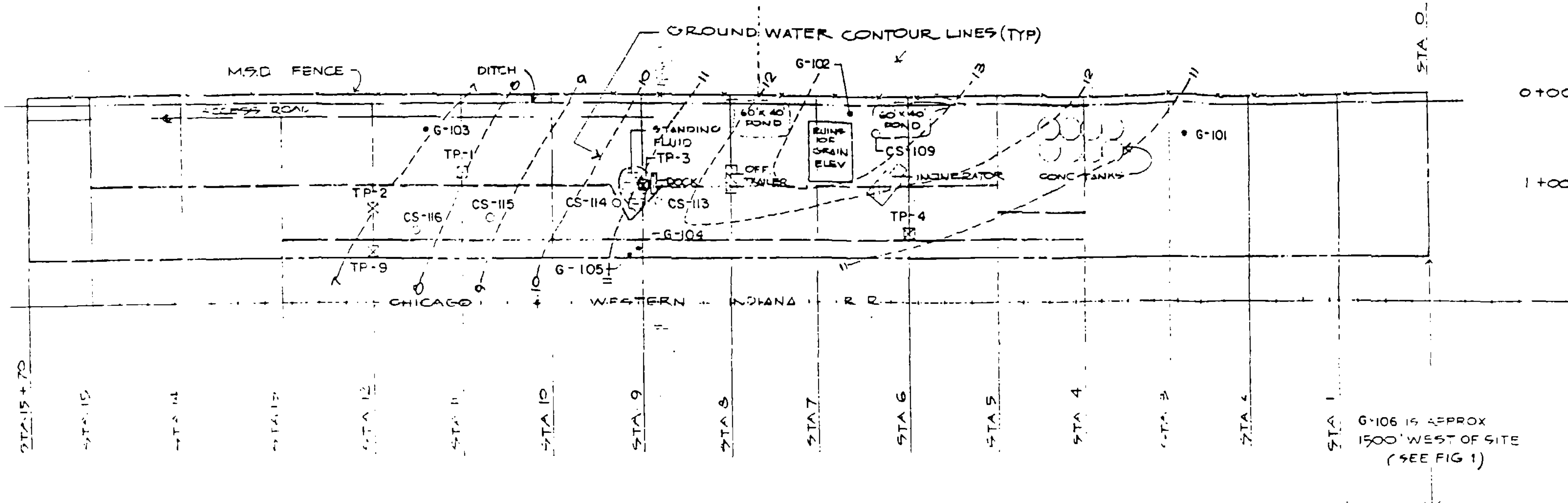
FIGURE·3




FIELD EXPLORATION LOCATION DIAGRAM
PENN CENTRAL SITE
CHICAGO , ILLINOIS

SOIL TESTING SERVICES, INC.
111 PFINGSTEN ROAD
NORTHBROOK ILLINOIS 60062

APPR MES 6-3-1981 22063
REV. 3-23-1982 BY MGS




LEGEND

- SOIL BORINGS/ MONITORING WE
- SURFACE SAMPLES (LOCATIONS B
- TEST PITS
- MAGNETOMETER TRAVERS
- * BASED ON GROUND WATER LEVEL O BY THE ILLINOIS E.P.A. IN OCTOBER

GROUND WATER CONTOUR MAP *
U.S. SCRAP SITE
CHICAGO ILLINOIS

by SOIL TESTING SERVICES,

REV. 4-8-1982 by MGS

APPR MES 6-3-1981 STS Job No. 2

REVISED 3-27-1982 by MGS